ALL-OUT WAR PRODUCTION ISSUE

OCT. 14 1942

AUTOMOTIVE and Aviation INDUSTRIES

OCTOBER 1, 1942

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6 ADAPTING OLD MACHINES TO NEW USES
7 CUTTING WASTAGE
8 BREAKING PRODUCTION BOTTLENECKS
9 USING EVERY MACHINE TO THE FULLEST EXTENT

Five of the nine suggestions for "Increasing Plant Efficiency" in WPB's PRODUCTION DRIVE include problems in which Standard Lubrication Engineers can give you valuable help. For instance:

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The Engineering Bulletin, "Storage and Handling of Lubricants," may have a few timely suggestions for you to help prevent wastage caused by contamination of lubricants in your plant. It will be particularly helpful to new men in charge of lubrication. A copy will be sent you without obligation. Just write Standard Oil Company (Indiana), 910 S. Michigan Ave., Chicago, Illinois.

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AUTOMOTIVE and Aviation INDUSTRIES

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All-Out War Production Issue

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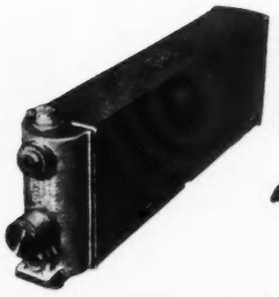
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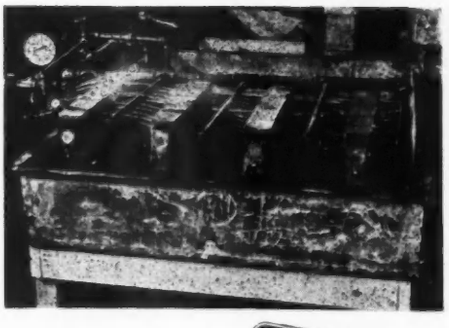
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(Right) Alternately filled with high pressure steam and sprayed by cold water, these YOUNG tank oil coolers are being tested for ability to expand and contract without developing leaks.

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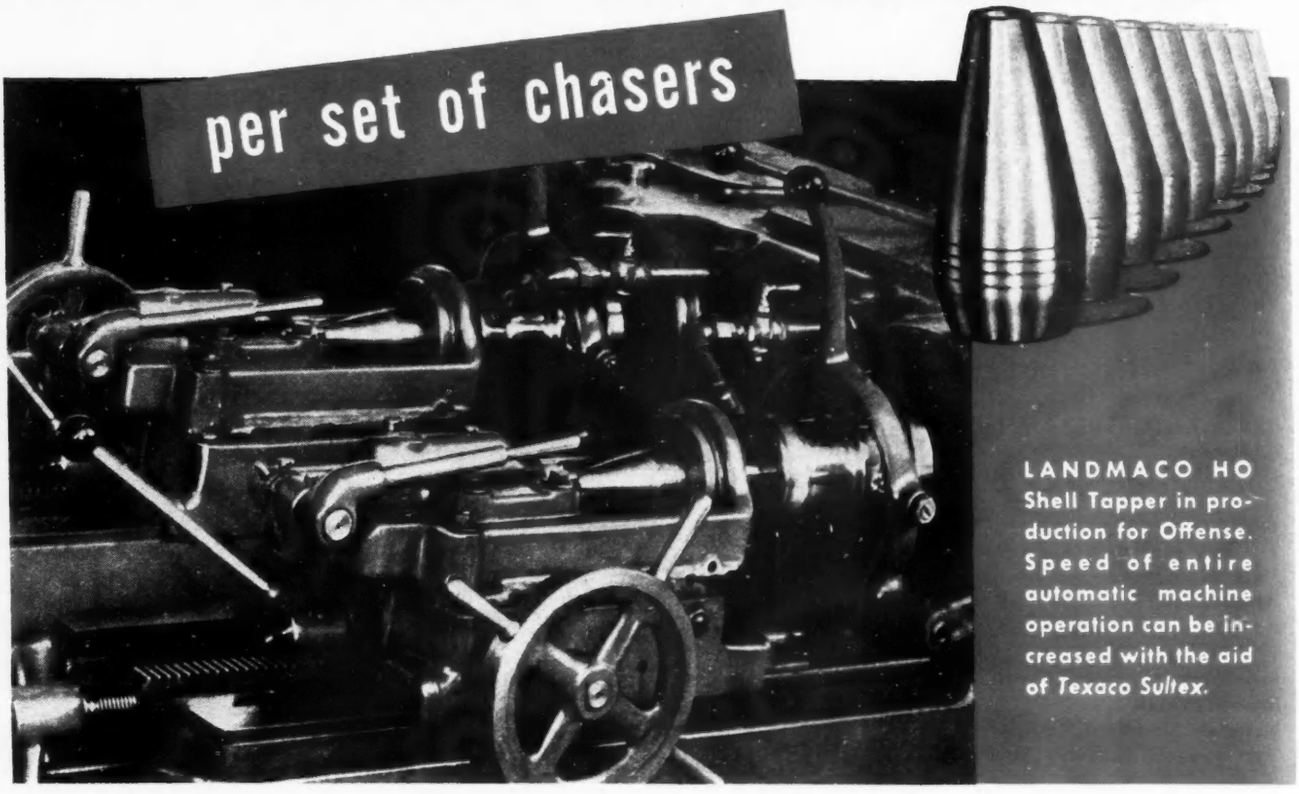
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FOR THE METAL-WORKING INDUSTRY

HELP WIN THE WAR BY RETURNING EMPTY DRUMS PROMPTLY

IN THIS ISSUE . . . .

AUTOMOTIVE and AVIATION INDUSTRIES

Volume 87 October 1, 1942 Number 7

AUTOMOTIVE INDUSTRIES

Reg. U. S. Pat. Off.

All-Out War Production Issue

The Automotive Industry at War 49

In this article Alvan Macauley, president of the Automotive Council for War Production, takes one on a journey through the industry showing what has been done, and pointing out the big things that are accomplished in the great war effort.

Conversion Almost Complete 52

That the automobile industry has been converted to an all out for war effort has been a moot question in some minds. In this article that story is told in its entirety with some real surprises for the doubters.

Production for Victory 56

Beginning the second paragraph of this article the author says: "But Pearl Harbor changed all that." That is really the whole story for, from that point on, the reader is carried through production schedule after production schedule with a clear view of the tremendous volume of war equipment ever in the foreground.

The Role of Metals in the War 60

With scrap drives in the headlines of our daily press one might wonder just where we are headed in our needs of the vital metals. Where they are coming from and what we have to do with, is brought out into the open all from authoritative sources.

Major War Products of the Automotive Industry 64

You will be surprised to learn of the wide variety of products that the automotive industry is turning out in their war effort.

The Replacement Parts Outlook 74

Both passenger cars and trucks are essential to the successful outcome of the war efforts. A certain number of replacement parts are necessary to keep them on the road. With the major part of manufacturers on war programs the question comes to mind "what about replacement parts?" Here the general manager of the association of replacement parts makers comes forward and shows what is being done that the cars and trucks shall keep rolling.

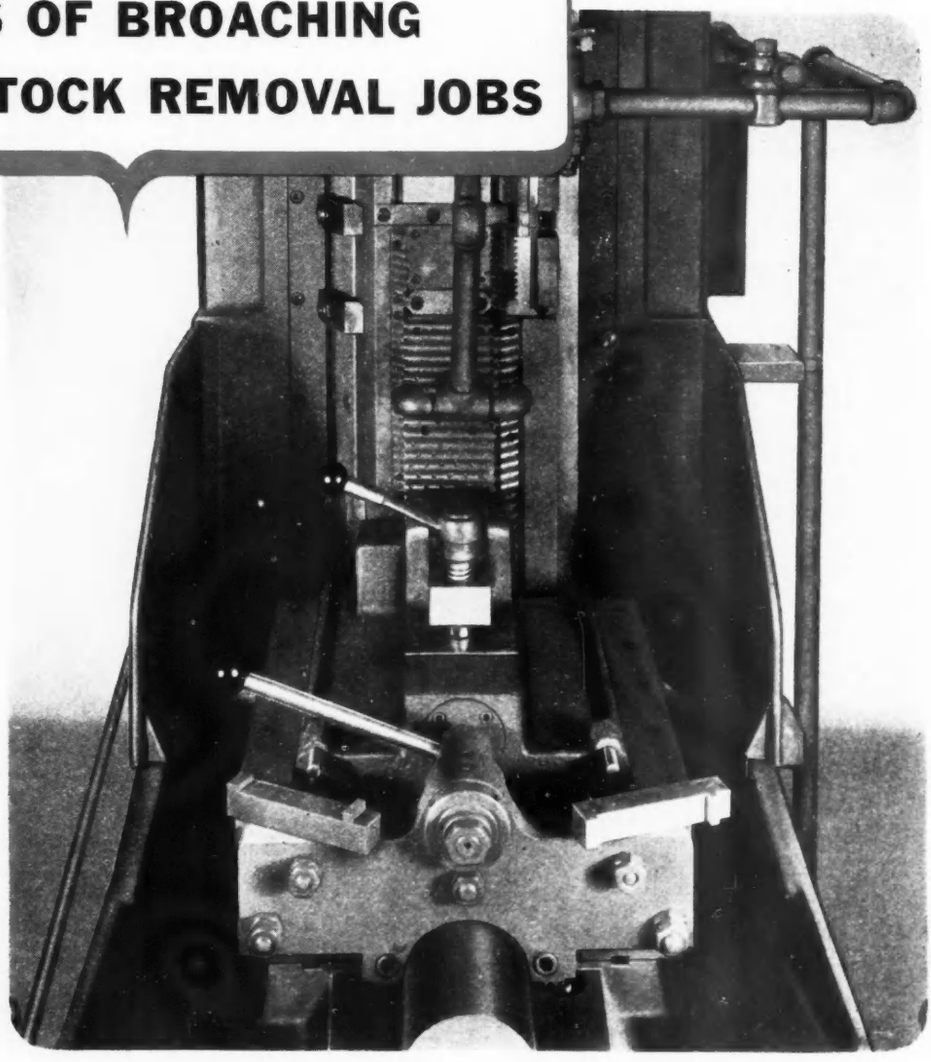
Production Short Cuts at Aircraft Plant 78

When the orders came for the automotive industry to start things rolling toward the battle fronts the engineering brains of the industry went to work with a will. They have accomplished wonders and some of these are shown and described on the pages starting with 78.

Tooling Up for Victory 88

Machine tools cannot be built over night. Thousands of plants had to be expanded. With such a background, the accomplishments of the machine tool builders are nothing less than history making. The president of the Machine Tool Builders Association comes forward with a lot of facts and figures that are eye openers.

How to Obtain ADVANTAGES OF BROACHING ON HEAVY STOCK REMOVAL JOBS

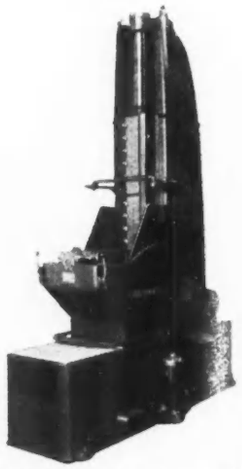


THE many advantages of broaching need no longer be confined to parts having conventional stock allowances. *Four times* as much metal removal, in some cases up to 5/8" depth of cut, can now be broached away. The secret lies in taking two or more cuts with the aid of a device for advancing the work to the cutters after each stroke of the rams. Inherent advantages of broaching are thereby retained . . . greater production; long tool life; small floor space.

Here's the way it was done with the equipment illustrated above — a CINCINNATI No. 10-66 Single Ram Vertical Hydro-Broach Machine. The parts are held in a hand-clamp fixture which is connected to the machine table by means of a bracket and screw. One stroke of the ram removes .190". Then the ram returns to the top of the stroke, and just before it repeats the cutting cycle, the operator moves the larger lever in the foreground through an arc of 180°, advancing the table and work .190" closer to the cutters. In this manner .380" is removed in two cuts to accurate limits. Production — 52 parts per hour.

Our Service Engineers will be glad to give you their recommendations for increasing production of your surface finished parts. Perhaps the specification catalogs will be of help to you: M-886 for the Single Ram Machines and M-894 for the Duplex (Double Ram) Machines.

CINCINNATI



● CINCINNATI No. 10-66 Single Ram Vertical Hydro-Broach Machine.

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All-Out War Production Issue

AUTOMOTIVE and AVIATION INDUSTRIES

Published on the 1st and 15th of the month

DOING MORE, FASTER, WITH LESS

Vol. 87, No. 7
October 1, 1942

The Automotive Industry at War

By Alvan Macauley
President of the Automotive Council for War Production

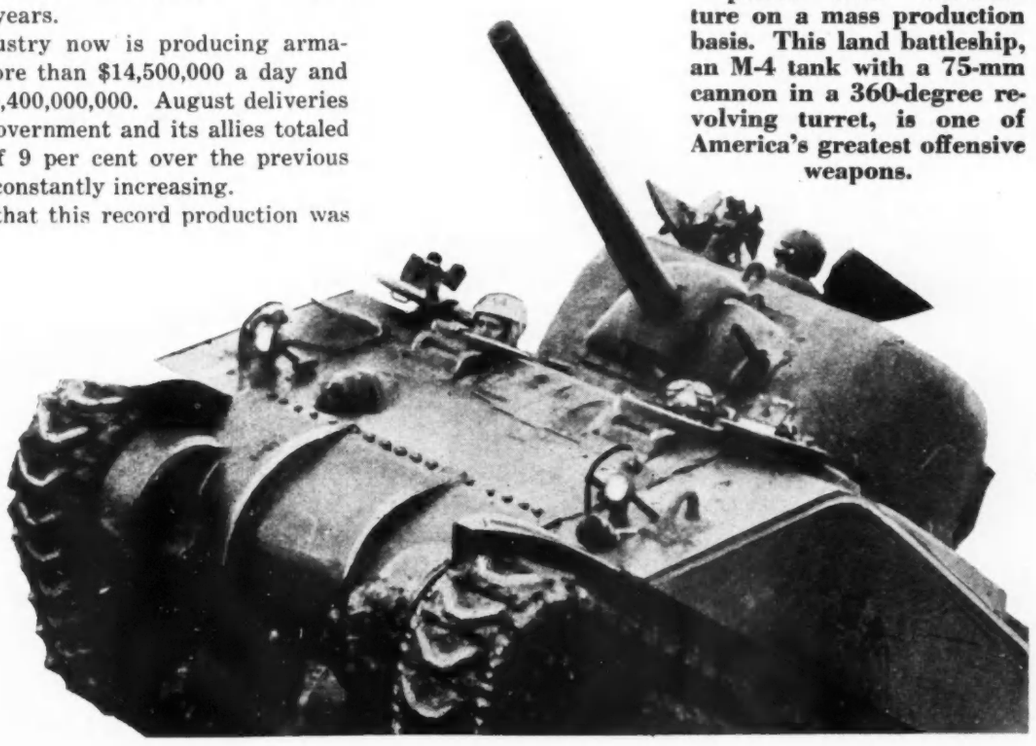
THE American automotive industry is now geared to the sole task of outproducing the Axis in military equipment.

In plants where only a few months ago passenger cars and trucks were rolling from assembly lines, today tanks, aircraft engines and fuselages, marine engines, guns, shells, military vehicles and many other war items are being turned out in quantity. But today's volume already is greater by far than that achieved in peacetime years.

The automotive industry now is producing armament at the rate of more than $14,500,000 a day and at an annual rate of $5,400,000,000. August deliveries to the United States Government and its allies totaled $450,000,000, a gain of 9 per cent over the previous month, and the rate is constantly increasing.

In view of the fact that this record production was achieved in a period that was generally one of bringing new facilities into operation, of retooling or converting additional automotive production equipment, of training workers in new skills, the progress to date assumes greater importance.

For with these problems of adapting automotive mass production techniques to armaments manufacture now overcome, the real outpouring of the tools of mass-destruction lies just ahead. The superb production to date leaves no doubt in the minds of the people of the automotive industry—from the shop benches to the



THE automotive industry placed tank manufacture on a mass production basis. This land battleship, an M-4 tank with a 75-mm cannon in a 360-degree revolving turret, is one of America's greatest offensive weapons.



desks of management—that infinitely more can be turned out. There will be no resting on laurels, so long as our fighting forces and those of our allies need one more gun, one more tank, one more engine.

The road traveled thus far has been a rocky one. From the beginning of the defense program, the industry was conscious of its responsibilities and many Army and Navy projects were already in mass production, when the Japanese struck at Pearl Harbor. Generally, however, orders were slow in coming. The Army and Navy were seeking appropriations for sorely needed war equipment, but these funds granted were for a defense program, not a war program.

The early December cloudburst of Nipponese over Hawaii threw the country into a war fever. Indifference turned to anger. Overnight everyone became impatient and wanted war production on a mass scale. The automotive industry became the target of criticism for its alleged slow rate of conversion to war. Actually, as has been pointed out before, it was not a case of slow conversion but rather a case of changed psychology.

This can best be shown by taking a brief glance at the record, beginning with the invasion of Poland in September, 1939:

With the opening of hostilities in Europe, the quick response of the United States was a declaration of its neutrality. Armaments were barred to all belligerents. From coast to coast determined stands were being taken by religious groups, industrial groups, labor organizations, war veterans and many others to keep the nation out of war.

"Our place is to act as a peacemaker," was the typical comment heard.

THE Army needs these speedy armored cars and gets them and thousands of other military vehicles from the automotive industry.

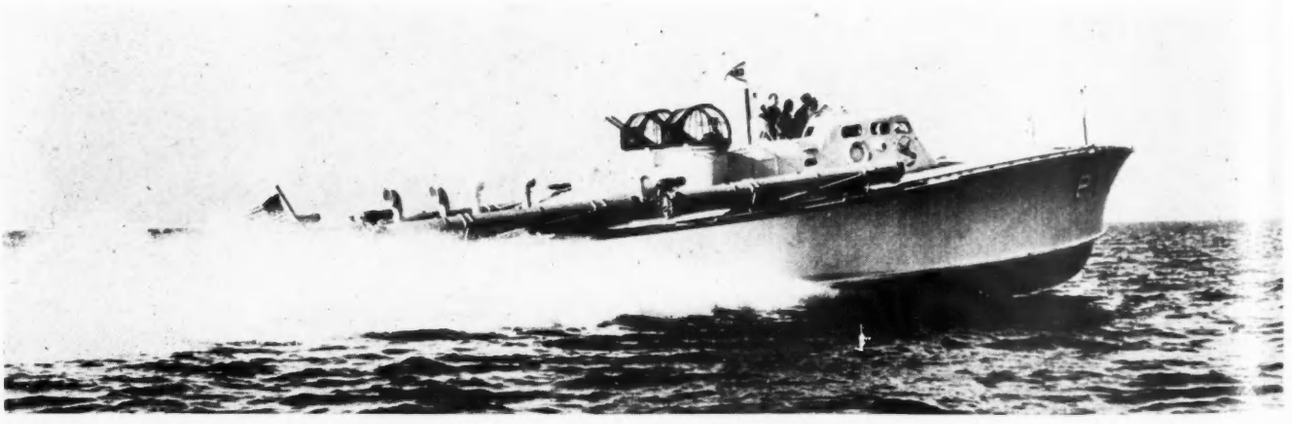


The Army, however, decided to take all possible steps toward building up its strength and six weeks later asked the automotive industry to submit bids on 12,000 cars and trucks. This was the first participation of the industry and at the end of the year, it was engaged in arms production to the extent of $20,000,000.

In April, 1940, Germany began its sweep of the lowlands, beginning with Denmark and Norway, and then advancing into the Netherlands, Luxembourg, and Belgium in May.

Shortly thereafter, President Roosevelt asked for

FROM the motor car plants, power and speed for many fleet auxiliaries of the Navy.





MANUFACTURING facilities of automotive plants have been converted to all-out war production. Machines that once turned out automobile parts now are used for the production of armament parts.



$1,182,000,000 for defense and indicated that the automotive industry would loom large in the program. William S. Knudsen, president of General Motors, responded to a call from the Chief Executive.

With the world stunned by the news of the fall of France in June, 1940, America began to take its arming program more seriously. On the whole, however, the nation was still very much determined to stay aloof from the European entanglement. Adding confusion was the fact that both major political parties were just beginning their presidential campaigns, with peace pledges issued daily by both camps.

Here and there, defense orders were sprinkled among automotive companies and by the end of August, 1940, total contracts amounted to $225,000,000. These orders were to be carried out over and above regular automobile production. The National Defense Advisory Commission let this be known by declaring that it had "no intention of interfering with normal automotive output."

Early in October, Knudsen came to the automotive industry for aid in quickly building up our air forces. Despite the fact that no orders would be forthcoming until the following spring, industry leaders set up the Automotive Committee for Air Defense and went ahead with preliminary planning.

In the closing days of 1940, the Office of Production Management was established to replace the National Defense Advisory Commission. Knudsen and Hillman were assigned the joint leadership of the new bureau. At year-end, $11,000,000,000 worth of defense contracts had been spread around the country. Of the total, the automotive industry had received orders amounting to $962,900,000.

During the first three months of the new year, the motor car industry became actively engaged in aircraft production. Several firms were given orders for engines, while others were asked to supply fuselages and other sub-assemblies for bombers. By the end of March, total orders had jumped to $1,335,400,000. So that nothing would stand in the way of defense production, automobile manufacturers called off the 1941

(*Turn to page* 240, *please*)

AUTOMOTIVE manufacturing methods that made possible mass production continue to serve the same purpose in making armament. Here leading edge sections for bombers are being spot welded at a former automobile body plant.



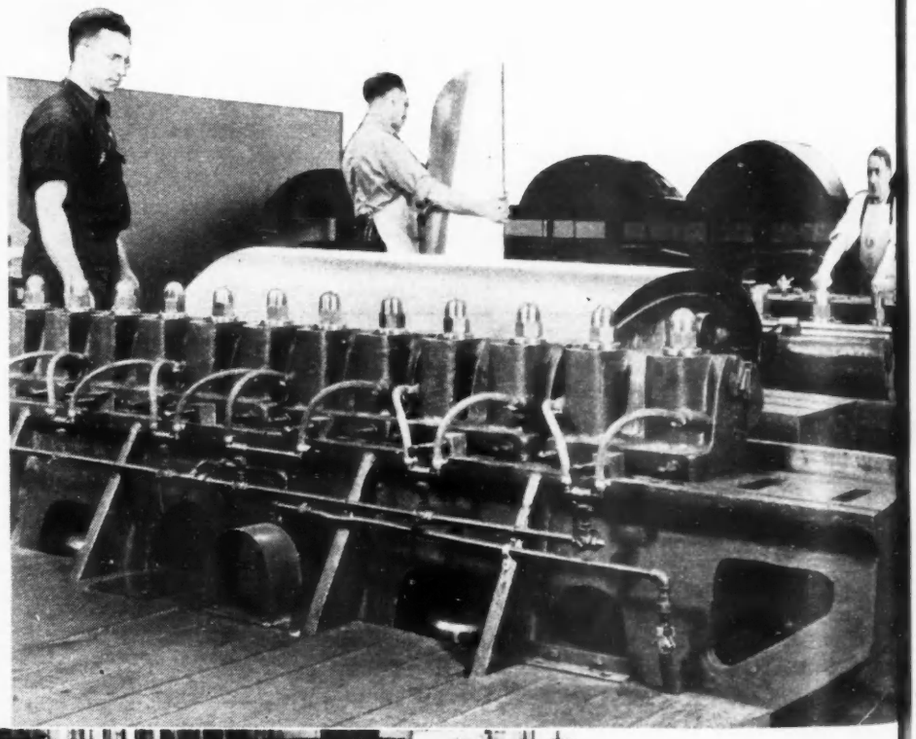
Conversion

Almost Complete

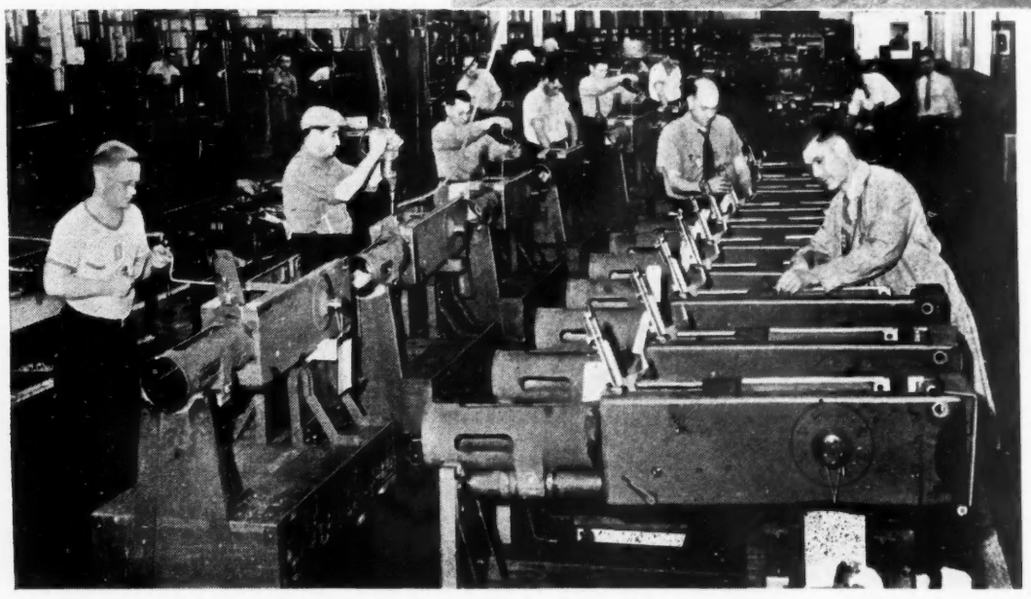
THE burning question of the day is, "Where does the automotive industry stand on complete conversion to war production?" It is answered by Alvan Macauley, president, Automotive Council for War Production, in this issue of AUTOMOTIVE *and* AVIATION INDUSTRIES. The whole story is summarized for the record, tracing the course of events before and after Pearl Harbor.

Has the automotive industry converted? The answer is emphatically YES. True, conversion still is going on. It has been a hard and difficult task to change over from automobiles and parts and accessories to materiel that had never been manufactured outside of military establishments. In fact, some of the war goods did not exist before.

What has been accomplished is an epic story, pointing definitely to still greater achievement. The initial stages of conversion are far behind us. Complete conversion is on the way. And that includes the participation of even the smallest parts and accessories plants on the roster of the industry. Our object here is to provide some of the more technical details of the conversion of the industry, supplementing the factual outline so ably provided by its spokesman.



This "skin-stretcher," a familiar sight in aircraft plants but unknown until recently in automobile factories, has been installed by Hudson to form the skin sections used in production of the rear fuselage for the Martin B-26 bomber. Operating a battery of these 300-ton hydraulic stretch presses are former automobile workers who have been trained for this work.



Employing automobile production methods, 40-millimeter anti-aircraft guns are now being assembled in large volume in a Chrysler plant. Above can be seen casings for these guns starting down the assembly line.

Weighing rough cast or forged from 400 to 570 pounds, barrets for 40-mm anti-aircraft cannons are machined, bored, rifled and finished by the thousands at automotive plants.



DOING MORE, FASTER, WITH LESS

By Joseph Geschelin

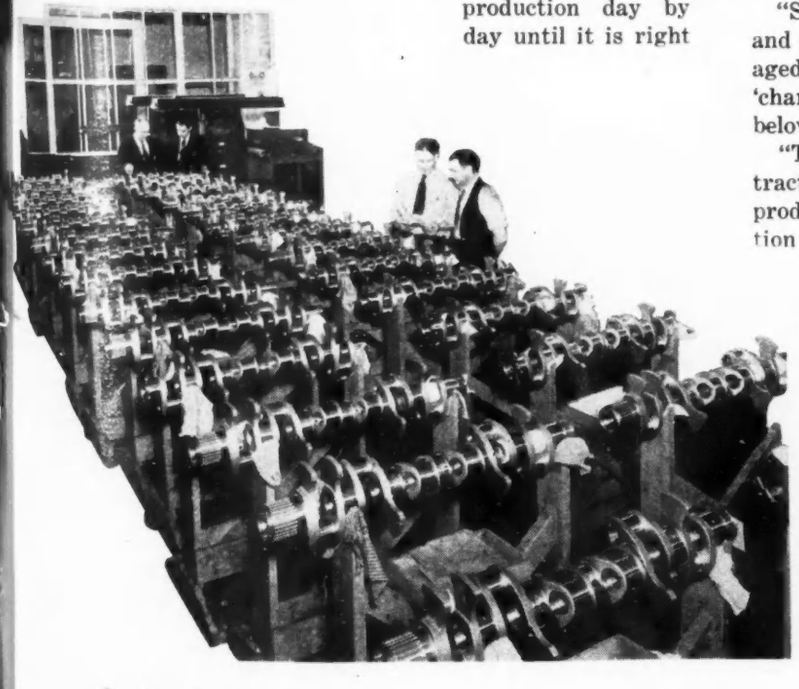
The Automotive Way

In an address delivered at the annual meeting of the ACWP on July 10, 1942, Paul Garrett, vice-president in charge of public relations, General Motors Corp.. made the following pertinent statements:

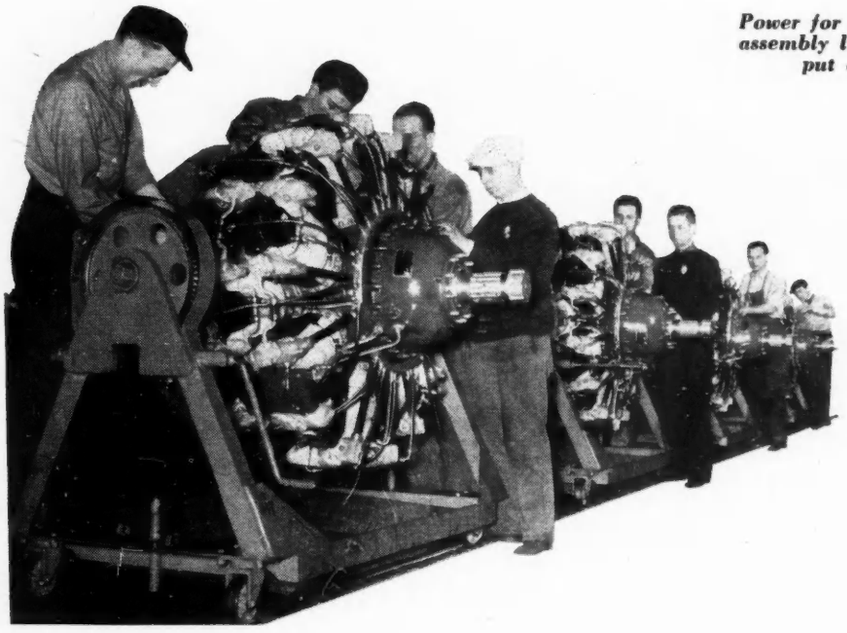
"First: Our industry has been able to accelerate war production day by day until it is right now delivering, for use by the armed forces, $12,000,000 worth of military equipment a day. That is a new feat in military history. It is the nation's evidence of what it can expect through mass war production to back up our armed forces for their ultimate victory.

"Second: Our industry, through careful planning and an exchange of tools, procedures and ideas, managed its shift to an all-out war effort with a maximum 'change-over' drop in employment of only 12½ per cent below December.

"Third: Our industry, long experienced in sub-contracting, has done an outstanding job in utilizing to productive advantage the skills, facilities and production capacities of its suppliers, parts makers and all its large group of auxiliary concerns included in the current term 'sub-contractors.' Outstanding, too, has been the contribution of these automotive suppliers through their efficient procedures, long established, which the industry has continued to utilize in tackling this new and highly technical job.



Allison aircraft engine crankshafts awaiting shipment from the Cadillac plant of General Motors. They pass hundreds of inspections before they reach this stage.



Power for a four-engined bomber rolls off the Buick assembly lines as this car manufacturer speeds output of engines for the Army Air Corps.



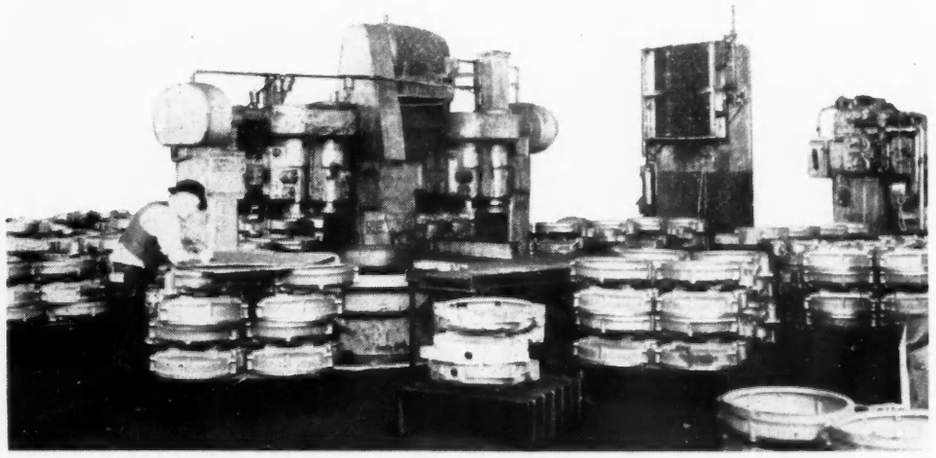
"Fourth: Our industry went through its critical period of change-over as a unit of private enterprise without need of Government control, through voluntary cooperation of a large group of manufacturers and suppliers—bent not on making an immediate showing so much as on laying the groundwork for a continuing long-range war production effort.

"Fifth: Our industry, in accomplishing all of these things, has been able in this short time to achieve a complete subordination of all normal industrial interests to the needs of a nation at war."

As an aftermath of Pearl Harbor the industry was asked to build 75 per cent of all aircraft engines, over one-third of the machine guns, more than two-fifths of the tanks and tank parts, more than half of the Diesel engines, 100 per cent of the motorized units, and many other items of military equipment. Since then the program has been progressively increased, intensifying the production effort, and spreading the task in an ever-widening circle which will shortly embrace every facility no matter how small.

The mass production techniques stemming from passenger-car experience have been applied to the manufacture of all of these things wherever the quantities are sufficiently large; in all cases these principles have been applied to the best advantage. Among the most valuable of the techniques, we can enumerate the following:

1. Principles of economical plant layout.
2. Utilization of materials-handling methods adapted to the job at hand; monorail conveyors for the transportation of parts and raw materials; assembly conveyors to facilitate assembly operations and to coordinate the flow of materials; industrial trucks for the movement of heavy loads; cranes, hoists, etc.
3. Utilization of specialized machine tools.
4. Improvisation to adapt existing machine tools to new tasks.
5. Development of jigs and fixtures to facilitate the handling and assembly of large and intricate parts.
6. Automotive gear practice in the speeding up of gear production for airplanes, for military vehicles, for all manner of military mechanism; particularly the adaptation of gear shaving as a means of reducing time and cost wherever the method can be applied.
7. Wide use of special cutting-tool materials such as the varieties of the cemented-carbides, particularly in the ma-



Pontiac adapts automotive machinery to turn out Diesel parts. This Newton four-head mill formerly machined cylinder heads for Pontiac automobiles. Now it has taken its place in the Diesel fly-wheel housing line to face castings faster than possible by the grinding method.

chining of steel; the use of cast cutting tools such as Haynes-Stellite; and a tremendous increase in the use of the industrial diamond, principally for dressing tools on precision boring machines, on internal and external grinders, on precision thread grinders, on cylindrical grinders, etc.

8. Use of the principle of motion study to develop the best procedures, speeding the assembly of small, intricate pieces, to provide a rational means of job analysis, and to develop methods designed to relieve operator fatigue.

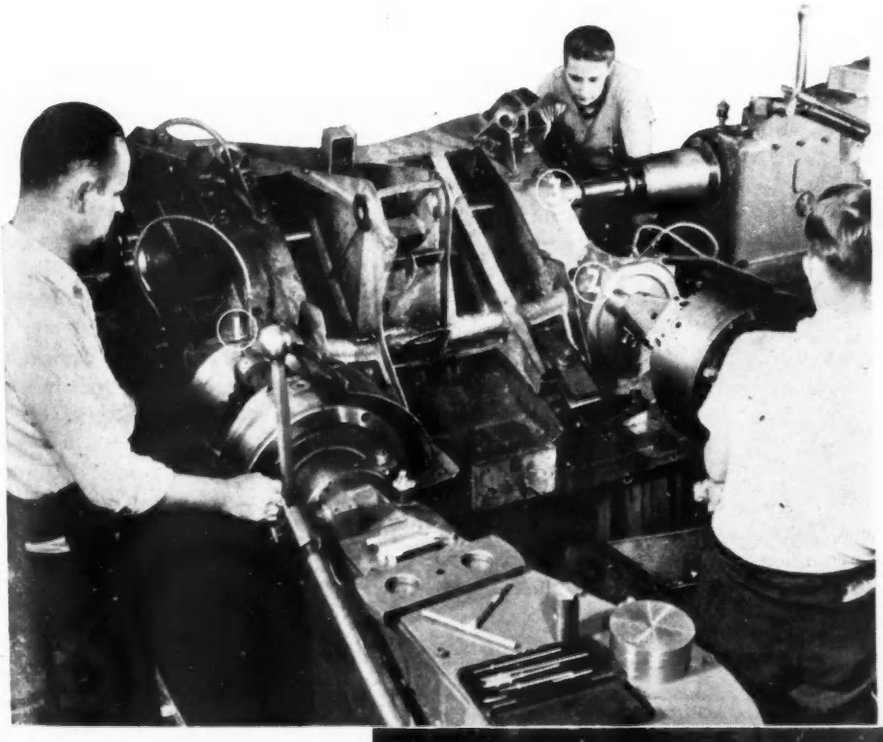
9. General adoption of the plug-in type of overhead power duct, which simplifies the installation and location of equipment and makes possible the shifting of machinery at will.

This list could be continued without interruption; its integration with the production-wise experience of the men of the industry forms a complete definition of what has been termed the "know-how"—the chief contribution of our industry. Know-how has made it possible to take on the most difficult tasks, to start with the methods used up to the present time, and then to progressively refine and improve upon them until the stamp of automotive experience is indelibly impressed on speed, quality, and cost reduction.

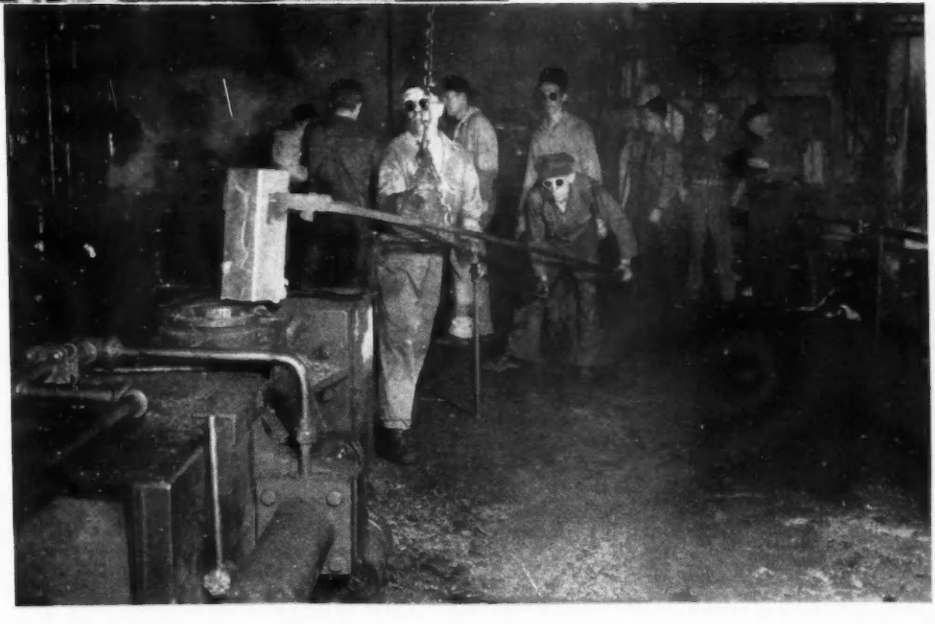
Cutting Production Costs

Despite the leveling effects of an all-out war program, the old competitive spirit still prevails within the ranks of automotive organizations. Each one takes pride in making ingenious short cuts, in developing specialized techniques, and in the application of its own talents to the end that the job will be done better for less.

According to industry sources, the prices on some of the items of war goods have been reduced as much as (*Turn to page* 226, *please*)



This three-machine setup, designed and built at the Fisher Ternstedt plant of General Motors for working simultaneously on an anti-aircraft upper carriage, is doing the work that ordinarily would require about seven machines and in considerable less time. Machines marked 1 and 2 are doing facing operations and at 3 a boring operation. In addition the difficult job of accurately setting the part in a fixture must be done only once instead of several times.



Workmen at Willys-Overland plant are removing the outer scale from a hot billet of steel which, after numerous other operations, emerges as a high explosive artillery shell. In the background is the gas-fired furnace in which the billet was heated with the resultant scale.

Production for

A YEAR ago the automotive industry had $2½ billion in "national defense" orders. Automobiles for civilan use still were coming off assembly lines at the rate of 80,000 per week and could be purchased without ration cerificates. Battles were being fought on the sands of Libya, the steppes of Russia and in the air over the English Channel, but Uncle Sam was not an active participant. Tires and gasoline were readily available to any buyer, without need of Government sanction.

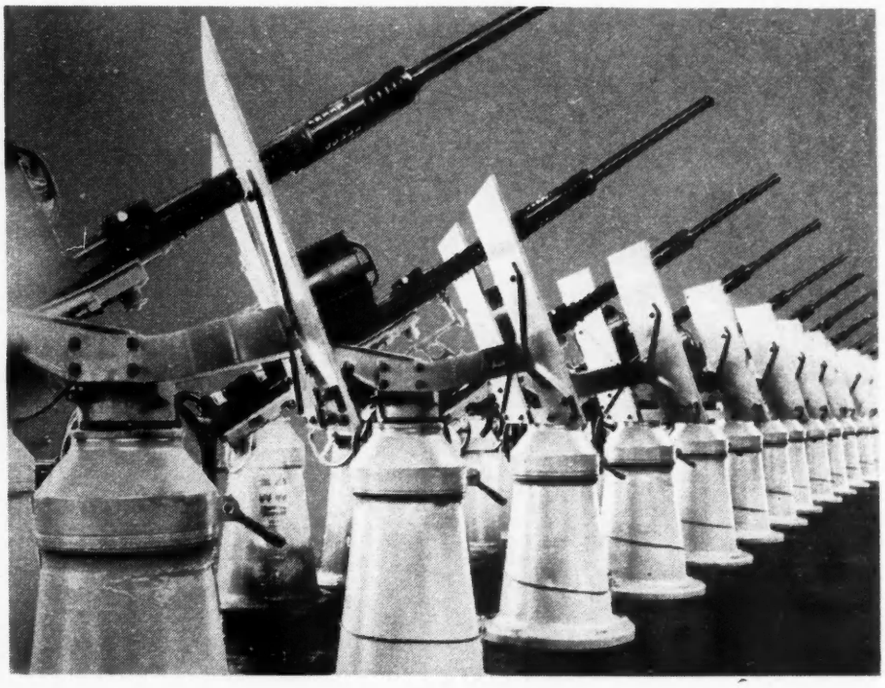
But Pearl Harbor changed all that. The automotive industry geared up for the greatest industrial effort in its history. War materials already are being produced at a rate of nearly half a billion dollars per month. Total orders awarded the industry so far approximate $15 billion. Peak annual production, provided materials and manpower are available, is estimated at $14 billion, which is equivalent to 15 million motor vehicles. That is three times the manufacturing volume of such record automotive years as 1929 or 1941.

General Motors Corp. alone has contracted to produce more than 10 per cent of the nation's war goods that are fabricated from metal. This corporation, with more than 90 plants engaged in war work, will turn out one-third of the machine guns, one-half the Navy's diesel engines, 40 per cent of the aircraft engines and more than one-third of the Army trucks ordered by the armed forces. Its 1942 deliveries of armaments will approximate the corporation's 1940 sales of $1,794,000,000 and war output in 1943 is estimated at $3,700,000,000. War shipments in the first half of 1942 totaled $628,439,000, which was 70 per cent of the total sales in that period. This compares with 17 per cent of 1941 output composed of war materials.

Chrysler Corp., with 27 major war contracts that will bring the peak rate of production close to the $2 billion mark, has converted 78 per cent of its automotive machinery to war production. Ford Motor Co., with 22 major war commitments on the books, also will near the $2 billion figure when top war output is achieved. This will be double the peace-time peak for both companies.

No longer do passenger cars come off the industry's assembly lines. Instead, hundreds of tanks, thousands of guns and millions of shells and fuses are being shipped monthly from plants of the automotive industry. Factory layouts have been completely altered, conveyors, presses and machine tools have been shifted here and there and both machinery and men have been converted to the task of all-out war production.

The intense rivalry that flourished in the days of highly competitive automobile salesmanship has been replaced by a spirit of cooperation which finds producers of the same military products working hand in hand over the solution of some manufacturing problem





"When the automotive plants were authorized to produce these anti-aircraft guns in volume, many of the parts had to be redesigned for mass manufacture. Several of the guns were of foreign design and the blueprints had to be converted to U. S. manufacturing practice."

VICTORY

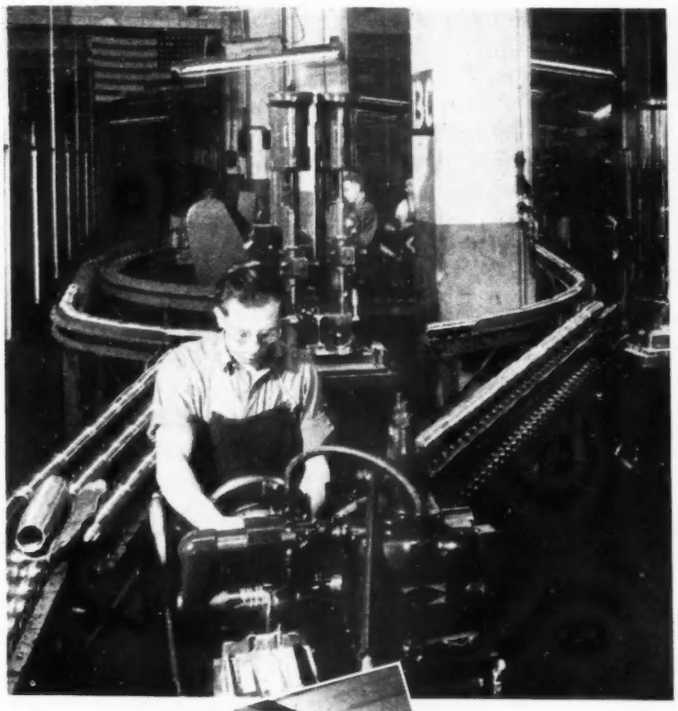
By E. L. Warner, Jr.

". . . millions of shells and fuses are being shipped monthly from the plants of the automotive industry."

that will mean a better gun or a more reliable airplane engine. Rivalry still prevails, but it is to see who makes the best tank engine or who is furthest ahead of schedule on aircraft powerplants.

Automotive manufacturers are pooling their engineering talent and their production know-how in order to make more faster with less. Cooperation between companies is now helping overcome bottlenecks in the production program and to improve manufacturing methods. Material substitutes, additional production facilities and time and cost saving techniques have been the outgrowth of this mutual effort, with beneficial results to both the armed forces and the people of the U. S.

The War Engineering Board of the SAE has undertaken the engineering aspects of this cooperative effort, while the War Products and Military Vehicles Division of the Automotive Council for War Production have directed the productive enterprise of the automobile makers into the interchange of information that has resulted in better armaments for Uncle Sam. The aircraft engines, airframes, ammunition, artillery and tanks and armored





"Now Willys and Ford are turning out jeeps by the thousands on automotive assembly lines to fill the needs of U. S. forces all over the world. So great is the cooperation that Ford furnishes certain parts to Willys."

cars committees of the ACWP usually meet monthly to discuss mutual problems and to offer tips on new methods. Many perplexing problems have arisen for the former automotive builders now engaged in fabricating light materials like aluminum and magnesium into aircraft engines and airframes and in welding bulky armor plate into tanks and armored cars. The Military Vehicles Division has worked closely with the Ordnance and Quartermaster departments in meeting the transportation problems of the armed forces. The automotive companies possess much needed background and experience in the truck and trailer field that has proved helpful to the Army.

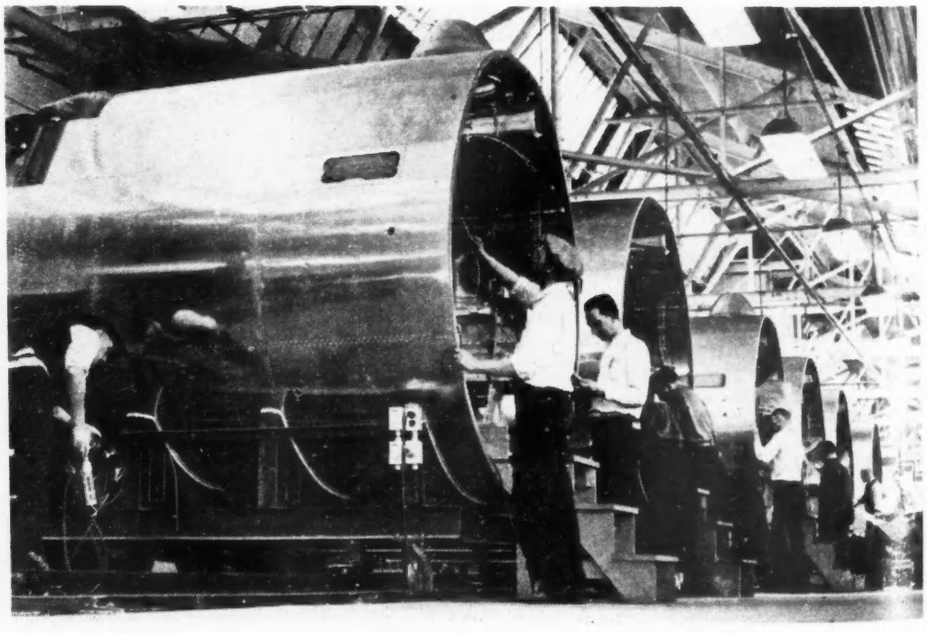


The committee meetings of the ACWP have made the representatives of the companies making the same armaments familiar with one another and have enabled them to work out problems on a friendly basis. A feeling of mutual trust has been built up among these former automotive rivals who now divulge the results of painstaking research that previously would have been well-kept trade secrets. Inquiries between plants are frequent when some production puzzle arises. Plant visits by the committees also are held concurrently with the monthly meetings. Committee members often jot down notes on various processes and shortcuts. Then they may send around some of their production aides to see the particular operation, collect data on it and then apply it to their own plant.

One of the largest automobile manufacturers gained some valuable information on tool maintenance on a visit to another plant producing aircraft engines. Substitution of one metal for another in non-functional parts, effecting a substantial saving in material and facilities that were urgently needed in other phases of the war program, was worked out by the tank committee of the ACWP. Another substitution of one grade of metal for another in certain engine parts was approved after the War Engineering Board had conducted some metallurgical research and then recommended specifications. Sources of supply for forgings, castings, gages and materials also have been located through the ACWP. In the early stages of conversion, the Tooling Information and Machine Tool Listing services of the ACWP were instrumental in expediting the preparation of automotive plants for armament output.

Last January President Roosevelt called upon U. S. industry to help achieve certain goals during 1942 in armament production. He called for 60,000 airplanes, 45,000 tanks and 20,000 anti-aircraft guns. All these goals may not be quite attained due to strategic considerations that have shifted materials elsewhere. But in the main they are being fulfilled and the automotive industry is doing its part to "keep 'em rolling, keep 'em shooting and keep 'em flying." It has been called upon to build 75 per cent of all the aircraft engines, over one-third of the machine guns, more than 40 per cent of the tanks, more than half the diesel engines and 100 per cent of the motorized units. In addition it is turning out such non-automotive items as air raid sirens, searchlights, combat helmets, shell boosters, field kitchen, gun directors, pontoons, propellers, shell hoists, tent heaters, and water coolers.

A recent survey by the ACWP shows that seven automotive companies are building complete aircraft engines in volume and two more are preparing to produce them. Nine companies are making airframe subassemblies and four are manufacturing propellers. Five companies hold contracts to produce complete aircraft of various types and two of these are nearing the completion of the long tooling period. Twenty-nine companies are turning out military trucks and seven are making combat cars and other armored vehicles. Eight automotive companies are making tanks and six are manufacturing marine engines. Seven companies are making artillery of various types and eight are building gun carriages.



"In order to augment the facilities of the aircraft industry, which itself accomplished a tremendous expansion program, the automotive industry was called upon to furnish engines and airframes for the huge air armada."

Airplanes

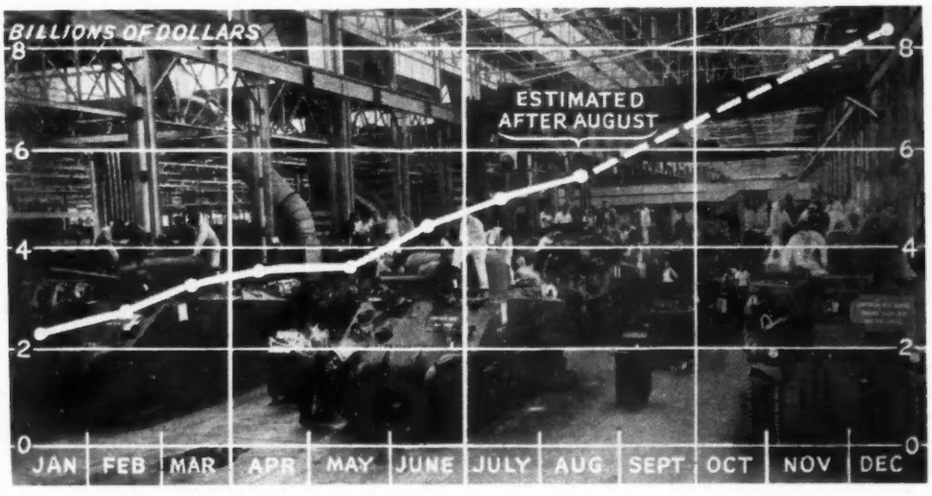
This is a war of the air in which U. S. armed forces are engaged, whether our planes be pitted against the Luftwaffe over France and the English Channel, Jap Zero fighters in the South Sea Isles or Stukas in the Libyan desert. In order to augment the facilities of the aircraft industry, the automotive industry was called upon to help furnish engines and airframes. Automotive engineers worked closely with aircraft companies to manufacture the bombers, fighters, aircraft engines and propellers. The technique of working with aluminum, especially in airframes, presented many problems but engines and airframe sub-assemblies are now flowing from automotive plants in constantly growing numbers.

With a capacity of more than 5,000,000 automotive engines per year, it is not surprising that the automobile factories have been called upon to produce 75 per cent of the nation's aircraft engines. The automotive engigineers have had to change the emphasis from economy to weight per horsepower but they have been successful in applying mass production techniques to a product which five years ago was ordered in 100 and 200-unit lots rather than by the thousand.

On Sept. 20, 1940, Packard Motor Car Co. signed a contract to make Rolls-Royce Merlin aircraft engines for Great Britain and the United States. Packard had made the 400 hp. Liberty engine in World War I and had 531 employes still on the job who had worked on that powerplant. But the Rolls-Royce Merlin has more than three times the horsepower of the Liberty. There was a long period of preparation during which 2500 English blueprints had to be converted to U. S. practices and nomenclature and finishes had to be respecified for manufacturing practice over here. Thirty thousand special gages, tools and fixtures had to be made or ordered. But the first test engine was completed May 13, 1941, and production began some months later.

Packard introduced the conveyor line to Merlin manufacture, an innovation to the English. Gang tapping and drilling of parts was a big time-saver compared to the English method. Packard makes 2000 of the 11,000 major piece parts, obtaining the other 9000 parts from 280 sub-contractors. The 11,000 parts in a Merlin compare with 7140 parts in a complete Packard automobile. Packard has introduced specialized teardown and reassembly technique in air-conditioned plant departments, which eliminates dust and reduces rejections. The engine also has been redesigned in part to save critical materials such as nickel, copper and stainless steel. A major change in carburetion and an improved method of case hardening gears also have been introduced.

With the company operating at more than double its peace-time peak, Packard is turning out Rolls-Royce Merlins in quantity lots for installation in British Spitfires and Lancasters and in Curtiss P-40s. Packard also has been producing powerful marine engines for PT boats for more than two years, supplying them to the U. S., British, and Soviet navies.



"There are 25,000 individual pieces in a medium tank (28-30 tons). Thirty to 50 per cent of the tank's weight is in armor plate. Fabricating armor plate is more akin to making locomotives or heavy machinery. Nevertheless, the automotive industry has taken on a major share of the tank orders, amounting to 40 per cent of the contracts for the land juggernauts." The chart superimposed on the photograph shows the 1942 war production progress of the motor car industry with annual rates given by months.

Ford Motor Co. agreed to build a high output Pratt & Whitney radial engine in the summer of 1940. A single cylinder of this aircraft engine would develop more horsepower than an entire 8-cyl, Mercury engine. Ground was broken Sept. 17, 1940, for a new plant and six months later, March 17, 1941, the plant was virtually completed. The first engine was finished Aug. 15, 1941, and a few months later volume output was achieved. Ford has introduced several innovations, including the centrifugal casting of steel cylinder barrels, which releases badly needed forging facilities and is reported faster and cheaper than forging. This saves one-third in material and four hours machining time per unit. Ford engineers have devised a "bootstrap system" of recapturing the electric power given off in test runs of the engines and using it to supply 53 per cent of the plant's total power demand. Another Ford improvement is the water-cooled arbor for grind-

(*Turn to page* 216, *please*)

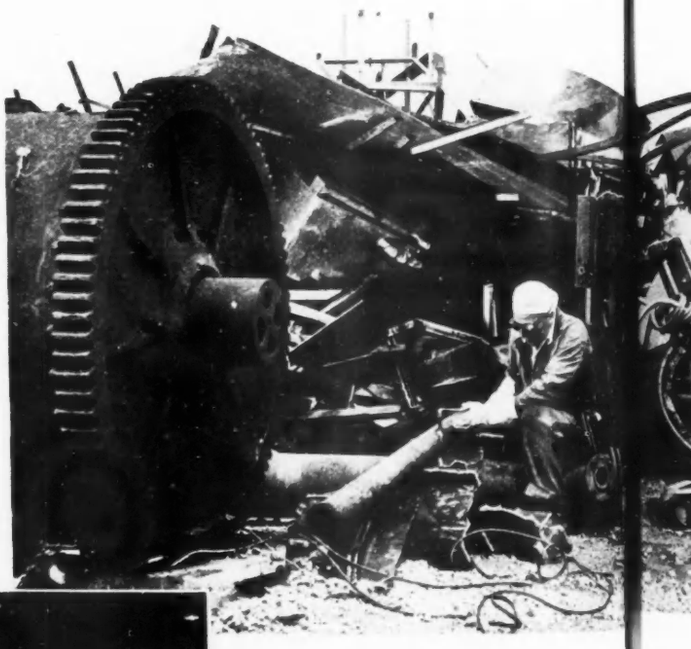


The Role of

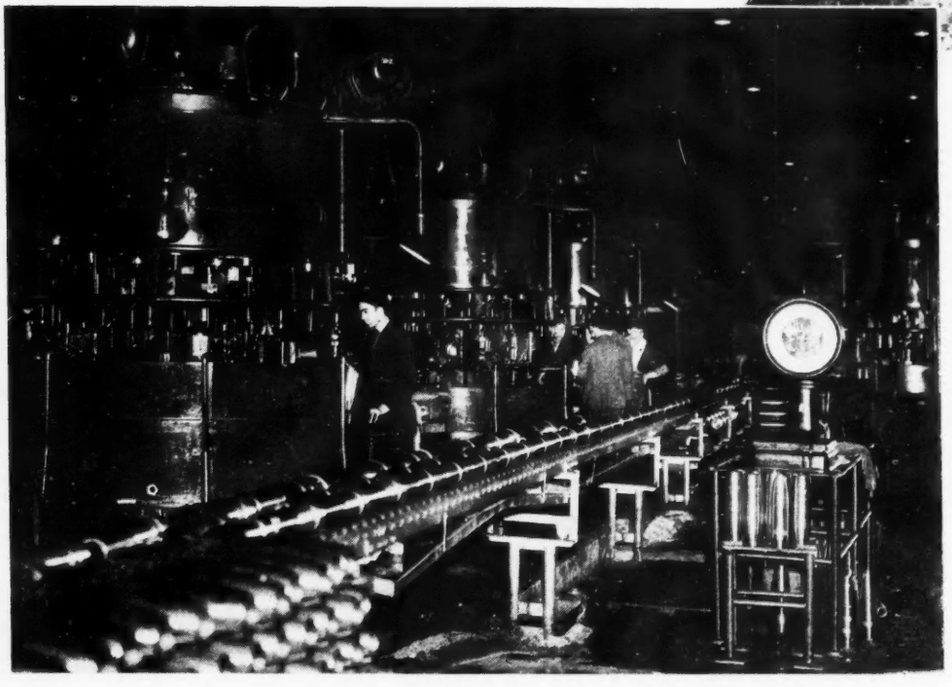
By
W. C.
Hirsch

PEARL HARBOR, focusing attention on the Pacific theater of war, together with the Japanese invasion of the Dutch East Indies and the Straits Settlements, warped for a time, but for a time only, ideas concerning where the shoe would pinch first and worst in our metal supply. Many thought that the cutting off of our usual sources of tin would create the major war material problem. Yet today, in spite of the fact that we are deeply concerned about the recovery of the 1½ to 2 per cent tin content of discarded cans, to augment our supply of this metal, it is the flow of key metals, such as copper, of which we had a glut not so many years ago, and of scrap iron, much of which we knew no better than to ship to the Japanese, that challenges the ingenuity of metallurgists and economic organizers. We have learned that, just as our strategists recognize this to be a global war, in which no one field of operations can be singled out as subordinate in importance to the others, no metal, ferrous or non-ferrous, is exempted from the war's pressure on production and the need of Draconic regulations in its use.

Lead, which so far it has not been necessary to subject to as severe control as the other metals, is beginning to reflect the increased demand resulting from the necessity of finding substitutes for many



Enough old metal to provide the scrap necessary to build two 35,000-ton battleships has been gathered by "Waste Wardens" in 90 GM war plants since the first of the year. Including the flow of production scrap from metal finishing machines, the total haul from General Motor's intensive scrap drive amounts to 531,000,000 pounds of iron, steel, copper, aluminum and other metals essential to the war effort.



Production of shells is constantly increasing in American munitions plants. Here a steady stream of shells flows along the conveyors in a plant of National Tube Co., U. S. Steel subsidiary.

Metals in the War

Today the supply and distribution of raw materials form the "Gordian Knot" which must be cut to provide adequately for defense needs and an orderly civilian economy. It is this problem that looms as the most difficult yet to face industrialists, military men and Government officials.

AUTOMOTIVE INDUSTRIES,
April 15, 1941.

white-metal alloys. So that there just can't be allowed any loophole in the control set-up that might permit the diversion of material, potentially useful in the prosecution of the war, to less important uses.

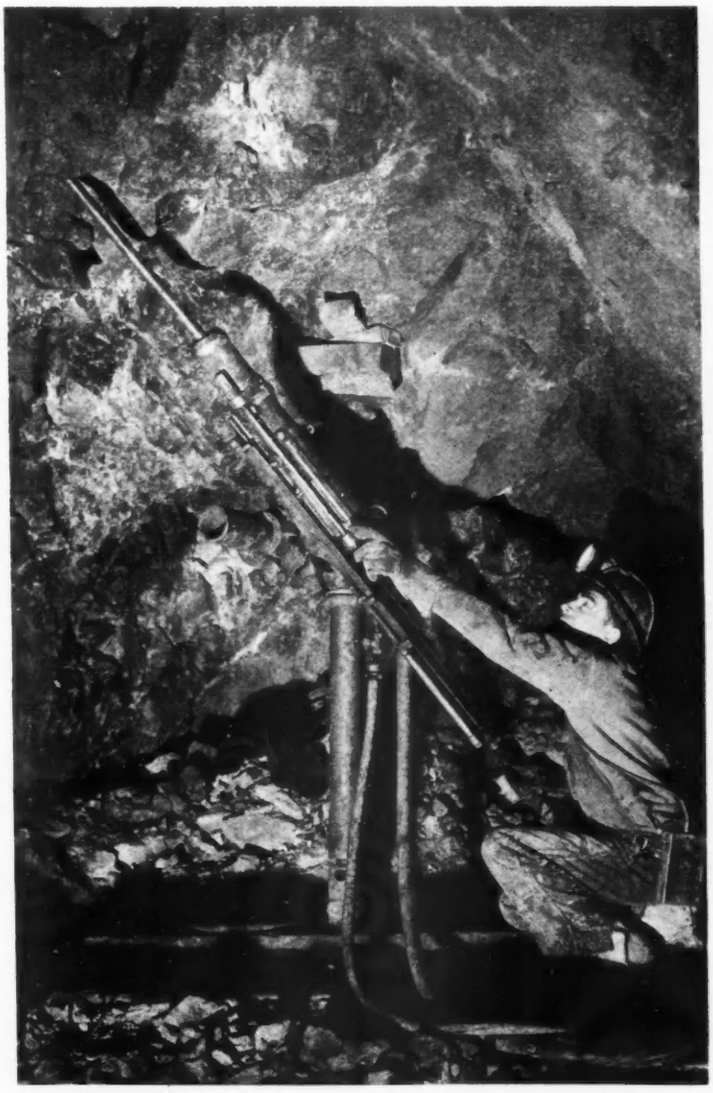
Perhaps the greatest step forward is the direction of obtaining a better balance between what will be required in the way of metals and what will be available is the Army's program for the next two years. This, according to General Brehon B. Somervell, chief of the Army Services of Supply, in an article in "Factory Management and Maintenance," will permit the saving of 2,000,000,000 pounds of critical materials by substituting others, not quite so scant in supply. The use of steel in cartridge cases in place of copper is expected to save 200,000 tons of the latter metal in 1942 and 1943. The 1942-43 program entails the following savings:



	Pounds
Aluminum	260,000,000
Nickel	63,000,000
Tungsten	20,000,000
Tin	30,000,000
Chromium	15,000,000
Zinc	270,000,000

These savings are to be accomplished by eliminating the use of aluminum in all non-aircraft production, further lowering of the nickel and chromium content of certain alloy steels, thinning of galvanized deposits, the substitution of steel for copper and zinc, wherever possible, and engineering refinements in other uses. Colonel J. H. Frye of the Ordnance Department set forth virtually the same picture in a recent article. The all-important point is that the engineering officers of the Services are working toward the same goal as the War Production Board's metal conservation experts, and are putting their heart and soul into these efforts.

Every child knows by this time that no war material exceeds in importance that of



Copper miner drills dynamite holes preparatory to blasting.

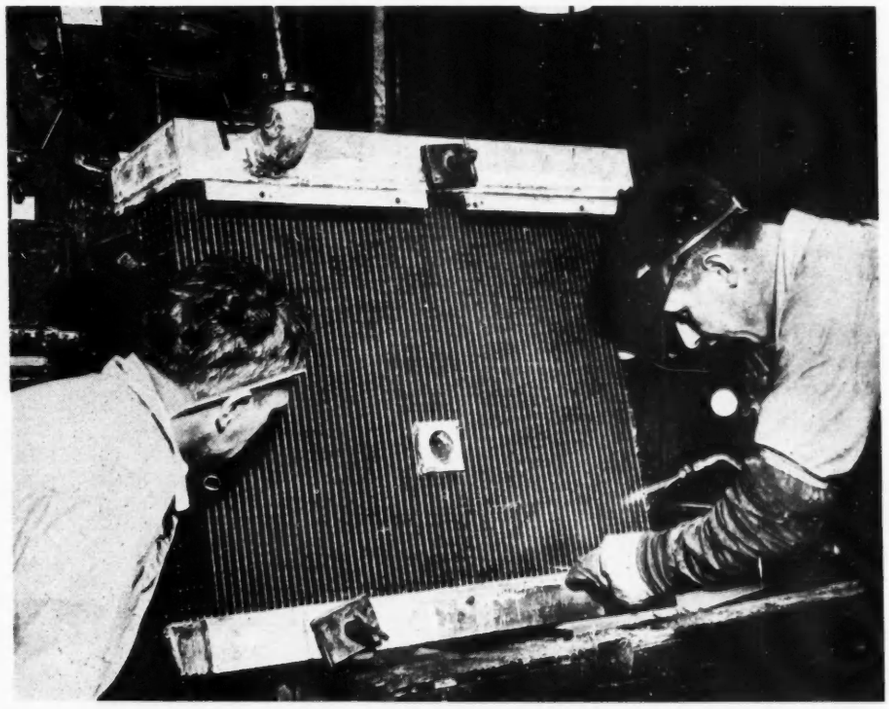
iron and steel scrap. Not so well understood is the fact that even if the supply of iron ore were many times as abundant as it is, scrap would still be eagerly sought, because the most widely used steel making process is predicated on the use of a certain percentage of scrap in the furnace charge, which also entails certain economies. While iron and ore shipments down the Lakes, which have been given the right of way over other commodities and which at this time are being speeded up more than usual in anticipation of the not far off close of navigation, indicate that the mining areas have been added to, steel producers stand pat on their contention that before additional furnace and steel making capacity can be advantageously employed, there must be a corresponding increase in the supply of metallics: iron ore and scrap.

According to the American Iron & Steel Institute, the country's steel-making capacity in round figures now is 90,000,000 tons a year. Plants under construction will add to this. Much of the continuing agitation for further expansion is based chiefly on a desire to augment the steel-making facilities of the Pacific Coast States. The American Iron & Steel Institute's week-to-week reports of mill capacity in operation, and the monthly reports of shipments by the leading producer, the only two statistical indices available at this time, denote a consistently high rate of production and shipments, thus showing performance of the industry as a whole to be of a high caliber in spite of frequently voiced complaints that it takes altogether too long to get urgently-needed steel.

Promulgation by OPA of maximum prices for some of the National Emergency steels indicates expanding utilization of alloy-lean steels in much of the current war material production. Further progress in this direction is certain to result from the continuing efforts of the American Iron & Steel Institute's committee of experts, who are working together with the War Production Board's Iron and Steel Branch and the Specifications Branch to make the supply of critical materials reach as far as possible. Of considerable help in carrying out this program is the better handling and reclamation of alloy scrap. There is still room for improvement in the methods used to conserve and reclaim alloy steel scrap.

Streamlining of the story of aluminum since the necessity for defense preparations was recognized at the time of the invasion of Poland, seems superfluous. Details of expansion in capacity, which by the end of 1943 is expected to exceed 2,000,000,000 pounds a year, must await the day when enemy ears can no longer profit from such disclosures, but information from responsible quarters makes it reasonably certain that plants now under construction will add sufficient to the aluminum supply in the course of next year that war or peace requirements can be adequately met. When we came out of World War I, our aluminum capacity was around 125,000,000 pounds a year. Whether savants, like Professor J. D. Bernal of the University of London, are right in predicting that this growth of aluminum capacity is the forerunner of an era in which iron and steel will be used chiefly for the making of tools and working surfaces and the light metals, aluminum and magnesium will take their place in many of their other uses, only the future can reveal. Certain it is that the needs of aviation will be met and that aluminum will play a still greater role in automotive construction than it did before the war. Capacity for the production of magnesium, according to Dr. Charles M. A. Stine, vice-president of E. I. du Pont de Nemours & Co., after the war will be more than double the aluminum output in 1939 (325,000,000 pounds). Sight should not be lost of progress in the laboratory which has accompanied the rearing of additional plants. The Official Patent Gazette recorded recently the granting of a patent for a 20 to 40 per cent beryllium, 1 to 8 per cent magnesium and the remainder aluminum alloy, which with the addition of small amounts of copper, zinc or silicon will yield virtually all the properties that may be required in different airplane parts, such as tensile strength under high temperatures, heat conductivity, resistance to fatigue, etc., without impairing the alloy's lightness.

Marked progress is also noted in what little information regarding nickel developments is available at



Copper goes to war in this heavy duty radiator for an Army combat car. This type of radiator is also used in tanks.



All rivets used in aircraft construction are carefully inspected before shipment.



this time. With the curtain of necessary military secrecy drawn over information regarding production and shipments, it is nevertheless sensed that deliveries into armament and munitions manufacture have been stepped up sharply. Nickel mining presents perhaps more difficult problems than the production of most other metals, workings being deeper, and spectacular increases in output can only be attained following prolonged development preliminaries. Meanwhile, the leading nickel company has thrown its full resources of technical talent into the battle for conservation of every pound of nickel scrap, and is carrying on a spirited campaign of education to that end, with excellent results.

With strict control not only over copper consumption, but copper products as well, not omitting scrap, war and essential civilian needs are being met relatively satisfactorily. The premium allowed to high-cost producers is bringing out urgently-needed tonnages. Enemy action in the waters, through which ore or concentrate laden vessels from South America must pass, is still a factor to be reckoned with, but overshadowed in importance just now by labor shortages in our own copper-mining states. At the consuming end, it is becoming more and more apparent that the use of copper in any application, where the metal's electrical conductivity is not the prime consideration, must be avoided as much as possible. So much copper is needed in the automotive and aviation industries for wiring and kindred electrical purposes that designers are well aware of this, and think twice before suggesting the use of copper, where another metal can be substituted without impairing efficiency, even though permanence might be a debatable subject.

Slashing of the uses to which zinc can be put, such as in building and in shells, where steel can be made to do the job, together with increased production, the most notable instance of which is the recent going into operation of an electrolytic plant in Texas for the production of High Grade metal, with a capacity of 24,000 tons a year, have eased somewhat the tight situation in the supply of zinc, a neck-of-the-bottle condition, which for a time was serious. Leading zinc producers are doing everything possible to supply the Government's war needs. Labor shortages are also painfully felt in this division of the metal industry.

For years the annual reports of the Bureau of Mines have carried stereotyped reports that tin production in Alaska amounted to fewer than a hundred tons. South Dakota, in fact, with an occasional output of a few hundred pounds a year in the Black Hills mining country, has at times given more promise of a worthwhile yield of tin than Alaska, but the sad fact, alas, is that there is no commercially promising deposit of tin anywhere in the Continental United States. Geologists say that there is something about the formation of the earth in this hemisphere, which makes such a find highly unlikely. With the scarcity of tin heralded on the front pages of newspapers throughout the land, it is quite understandable that ambitious dilettante prospectors with proof of rich tin deposits at their backdoors bob up in profusion these days. They are a harmless gentry, but every so often some one in Washington heaves a brickbat at the Government for not doing more about developing its non-existent tin mines, which may be funny, but not quite so harmless. As matters stand, we have to depend upon our reserve stocks of Straits Settlements and Dutch East Indies tin, plus what we may get from Bolivian ores after our new smelting and refining plant gets into full production, plus what we can reclaim from scrap. The Japs, probably for propaganda purposes, say that they are reconditioning the mines in Penang and intimate that they will be operating again in the near future.

(*Turn to page* 210, *please*)

Military Vehicles

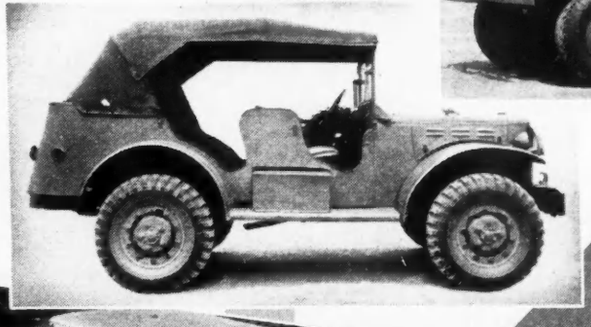
A continuous stream of military vehicles in many different types, ranging from quarter-ton reconnaissance cars to 40-ton tank transporters, now is flowing from the automotive factories to the nation's armed forces throughout the world. Virtually all sizes and types are equipped with all-wheel drive.

An Army armored division has 3500 motor vehicles of 160 types with a total of 400,000 horsepower. They consist of combat and armored cars; motorcycles; motorized units for transporting men, hauling guns, ammunition and supplies; and such mobile adaptations as kitchens, hospitals, machine shops, earth borers, liaison headquarters, electric power plants, pigeon lofts, telephone exchanges, water-filtering units, horse transports, searchlight trucks, radio trucks, repair and maintenance units, and others. Added to these requirements are special vehicles for other branches of Uncle Sam's fighting forces, augmented by various motor vehicles necessary for use at war plants.







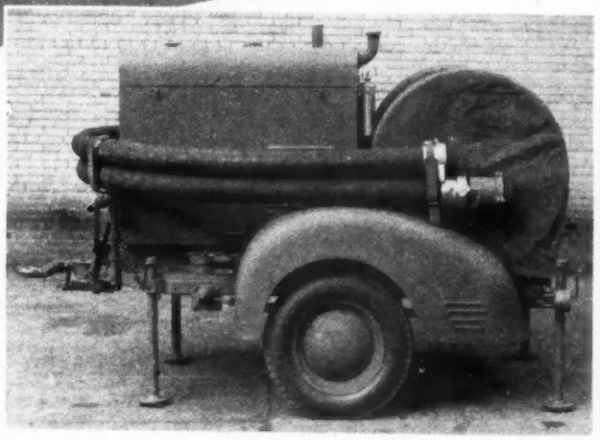


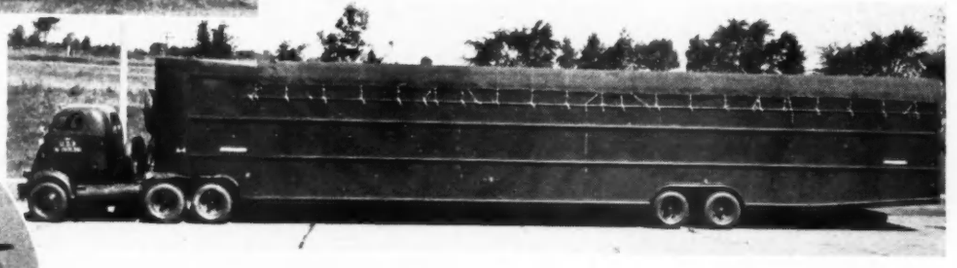




Major War Products of the Automotive Industry

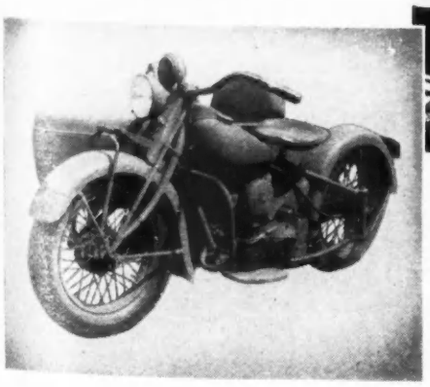








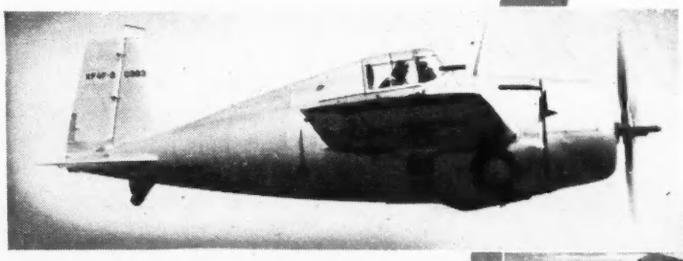


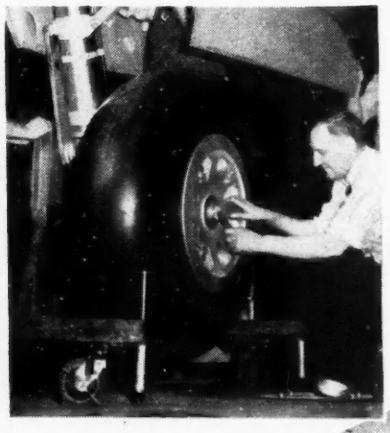




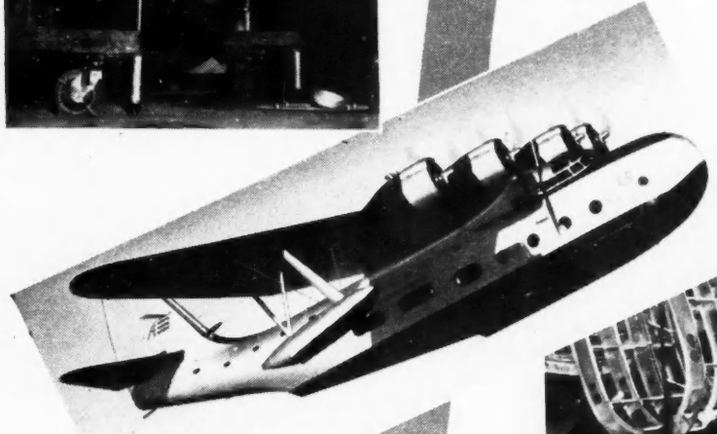
Warplanes

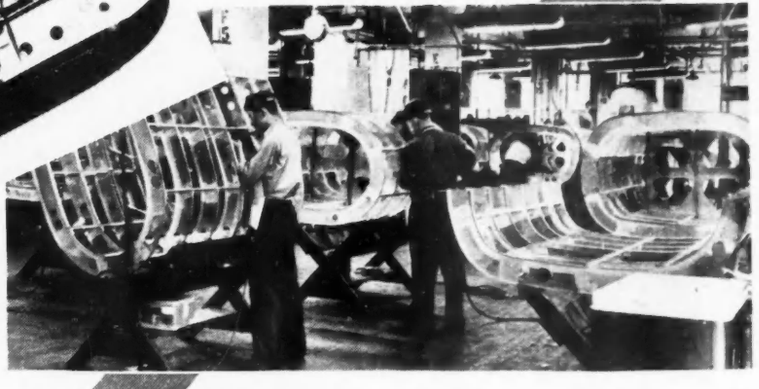
As their part in building America's air armada, automotive companies have undertaken the production of the complete bombers, transport flying boats, torpedo planes, fighters, and also sub-assemblies and parts for thousands of warplanes being assembled at the plants of the aircraft industry. The latter group includes wings, fuselages, landing gears, engines, variable-pitch propellers, tail surfaces, gun turrets, fuel tanks, instruments, electrical and other highly specialized equipment.

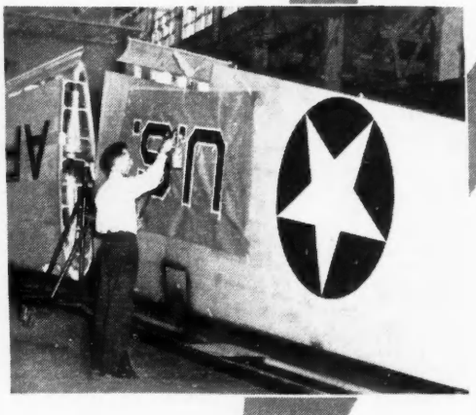














Major War Products of the Automotive Industry

Tanks

In mass production are land juggernauts of 13 and 30 tons for the Army, amphibian tanks for the Navy and Marines.

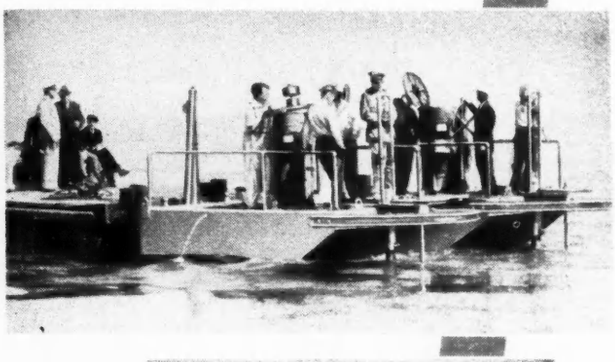


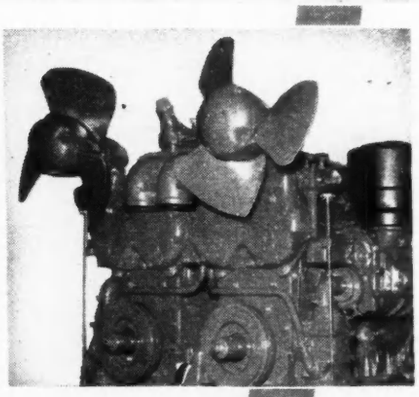


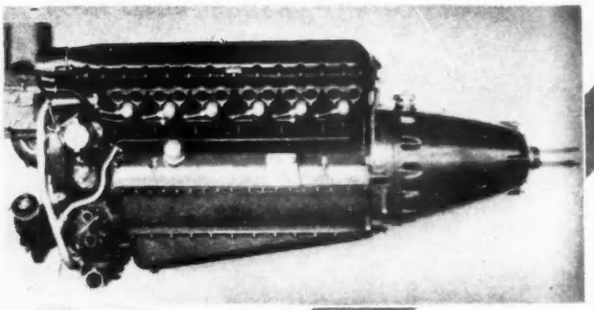


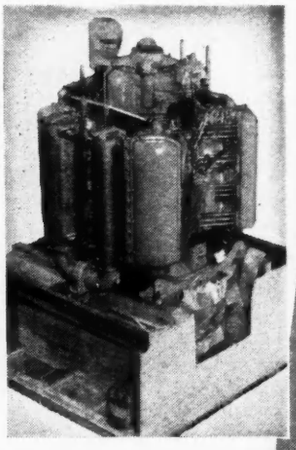
Power Plants

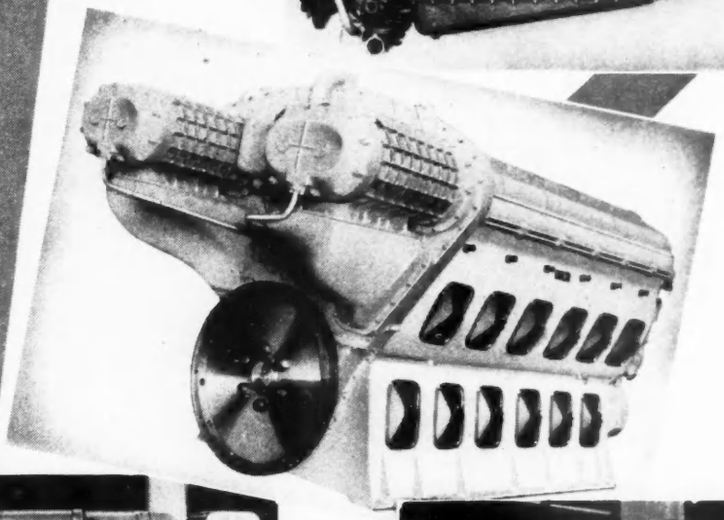
Dependable power for many of America's tanks, warplanes, naval vessels, and all military vehicles, is supplied by gasoline and Diesel engines designed and built by the automotive companies. These power plants vary widely in design, having from four to 18 cylinders, and developing from less than a hundred to thousands of horse power; they include two-stroke and four-stroke types, liquid-cooled and air-cooled, and practically all cylinder arrangements—in-line, radial, V, X, and horizontal. Coming from the plants are tank engines for the 13-ton and 30-ton mobile land fortresses; airplane engines for liaison planes, trainers, fighters and bombers; marine engines for destroyers, submarines, submarine chasers, escort vessels, mine layers, mine sweepers, landing boats, net tenders, seaplane tenders, fleet harbor tugs, coast guard cutters, cargo freighters, barge tractors and other naval applications; in addition, heavy-duty truck engines are being produced for thousands of military vehicles.

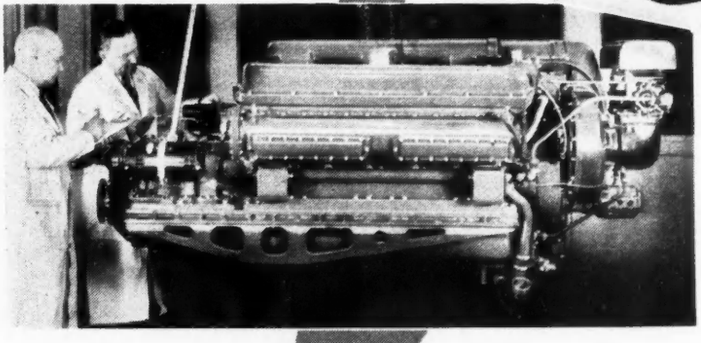


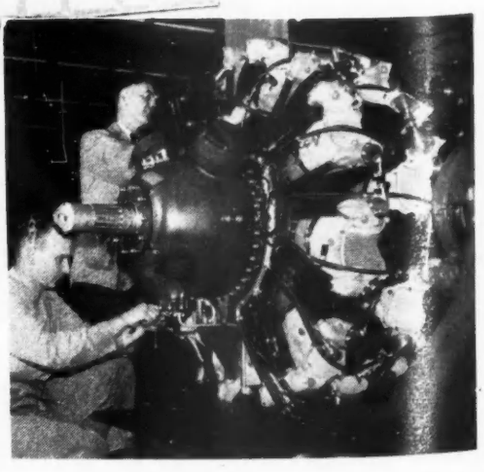








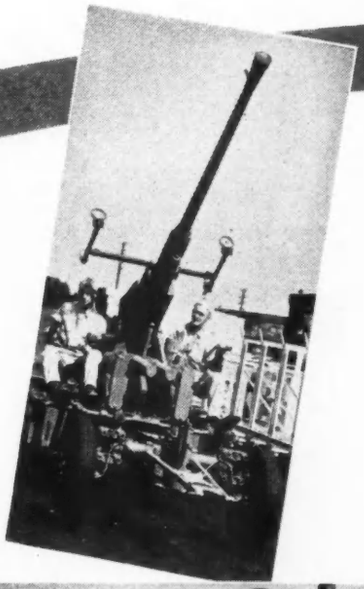




Guns and Cannon

Functioning as an important part of America's arsenal, automotive plants are producing many thousands of carbines, Browning and Browning-Colt machine guns, Bofors and Oerlikon anti-aircraft cannon, tank cannon, field artillery, ranging from .30-cal to 155-mm in size. Other equipment comprises a variety of breech blocks, recoil mechanisms, gun carriages and special control apparatus to direct the fire of anti-aircraft batteries.

Major War Products of the Automotive Industry





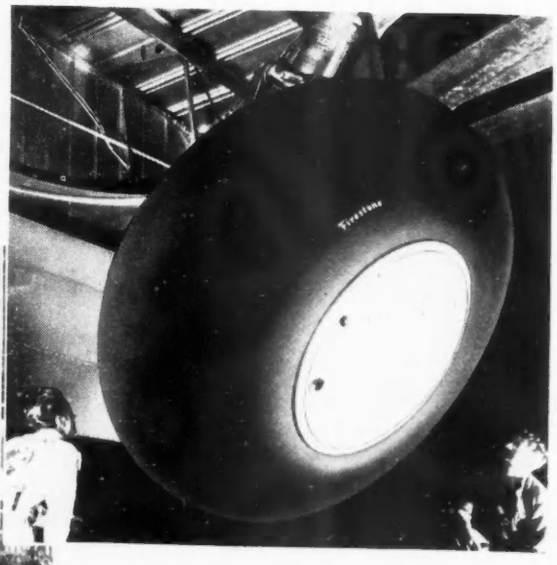




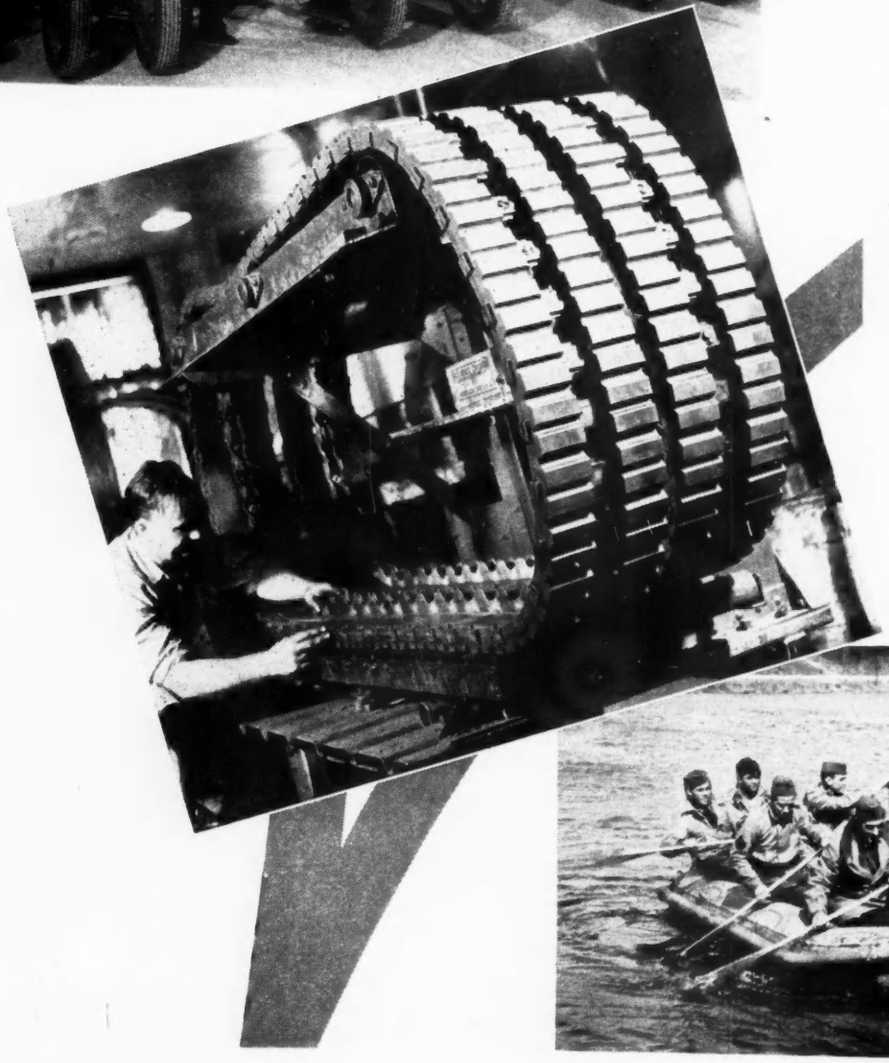


DOING MORE, FASTER, WITH LESS

Rubber Products





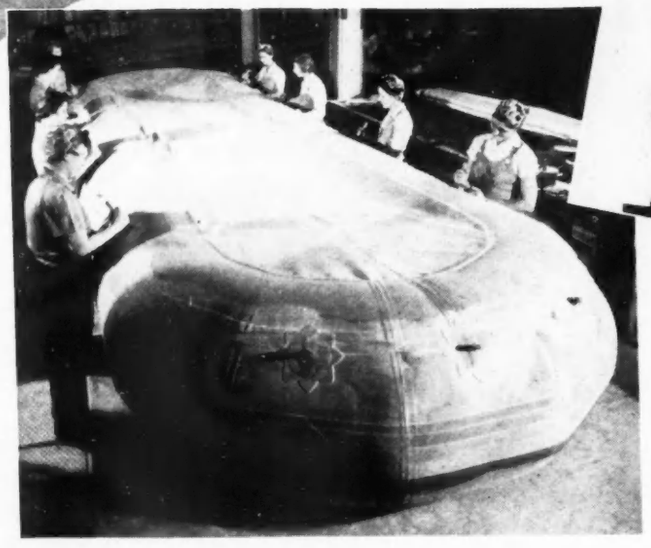






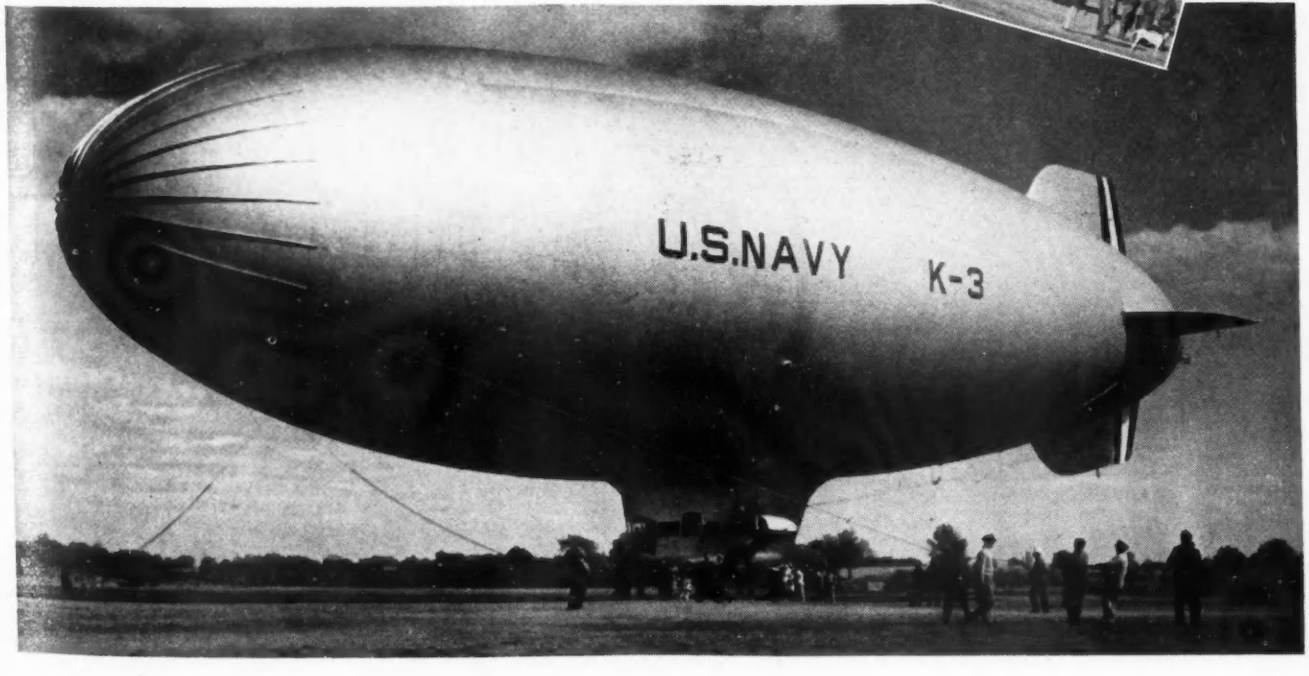
Major War Products of the Automotive Industry

From the plants of the rubber companies there flows a variety of war products in large quantities. Besides airplane and truck tires in numerous sizes and types, including run flat and zero pressure tires, fire hose, conveyor belts and other industrial items for war plants, it includes barrage balloons, patrol airships, emergency life boats, assault landing boats, rubber tracks for tanks, self-inflatable life boats, self-inflatable life vests, life saving suits, self-sealing fuel line hose and self-sealing fuel tanks for warplanes, gas masks, flotation bags, and large rubber pontoons, over which bridges can be built capable of supporting 30-ton tanks. A rubber company also is manufacturing Bofors 40-mm anti-aircraft guns and carriages at one of its newly-constructed plants.





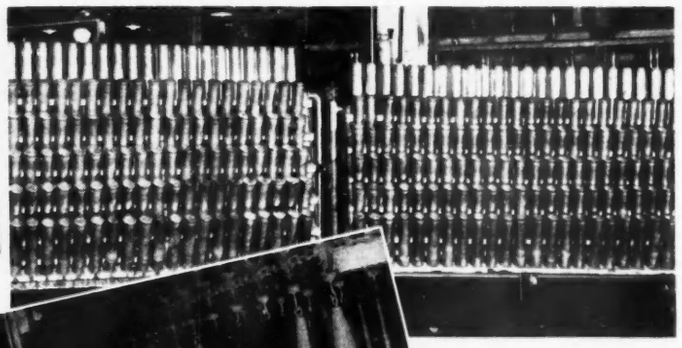




Shells, Bombs and Torpedoes

In ever-increasing quantities in the millions, projectiles in nearly every size from .30-cal cartridge cases to 155-mm artillery shells, as well as bombs and torpedoes, are being made for the fighting forces. Included are shells of the high-explosive and armor-piercing types, nose and tail fuzes, boosters, and bullet cores.



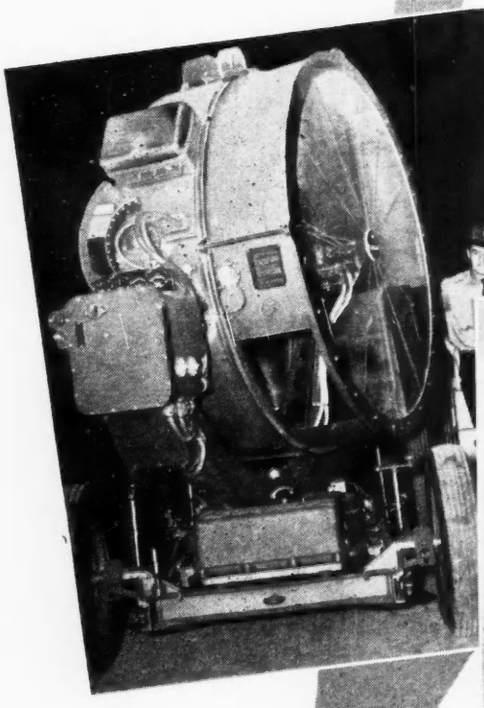




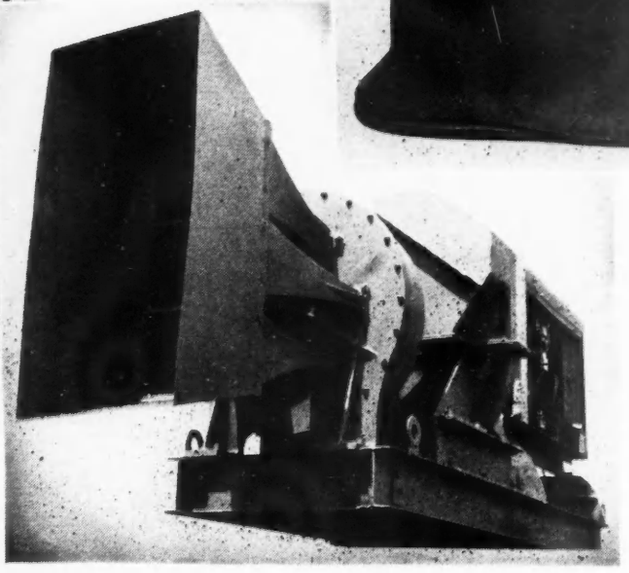
Helmets

Air Raid Sirens

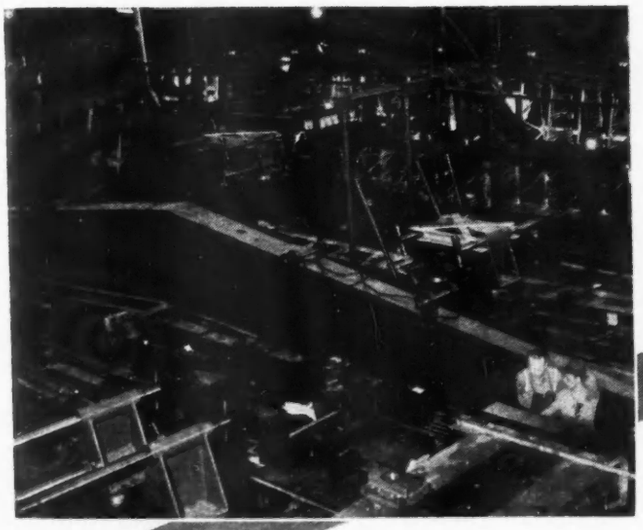
Searchlights







Major War Products of the Automotive Industry

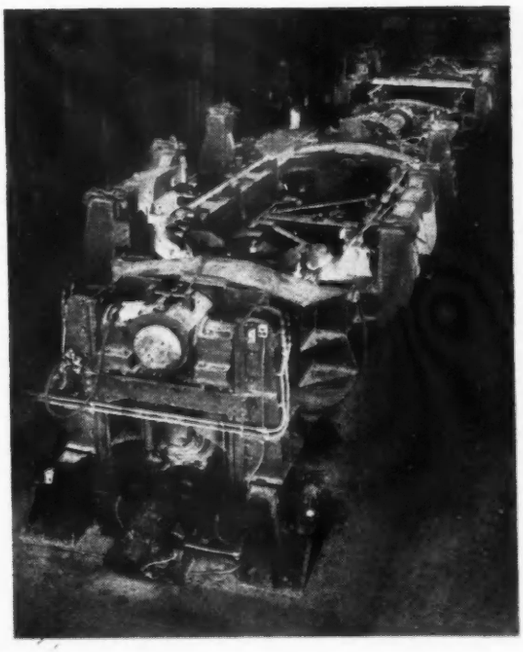




Plant Equipment

When the industry undertook new and complicated jobs of producing warplanes, tanks, guns, shells and other armament, hundreds of special machine tools, jigs and fixtures were needed to manufacture them on a mass-production basis. As it became difficult to obtain early delivery of many such special items, automotive craftsmen designed and built such equipment themselves to prevent delays in tooling up for production.







Replacement

By Frank Rising
General Manager, Automotive Parts & Equipment Manufacturers, Inc.

THE automotive parts industry has gone to war. Some 600 parts manufacturers, employing more than 300,000 men and women, are devoting better than 75 per cent of their facilities to war production. Their remaining capacity is being used to turn out vitally needed replacement parts to keep the nation's essential transportation system in operation. Jobbers, wholesalers and dealers also are doing their part to "keep 'em rolling" so there will be no breakdown in civilian transportation that might cripple the war effort.

The immediate outlook is promising. There have been few cases of motor vehicles being immobilized for lack of parts, probably little more than under ordinary peacetime conditions. Material shortages engendered by the war production program have caused difficulties in providing certain types of parts, but the ingenuity of the automotive industry in working out satisfactory substitutes has overcome many bottlenecks. Alternate materials for rubber, tin, lead, aluminum and copper have been developed in many cases to permit the manufacturers to continue supplying the motor vehicle users with repair parts. Limitation Order 158, now in effect, appears to be a reasonable and workable solution to the difficult problem of government regulations, although it may work hardships in some cases.

The long-range view is hedged with more uncertainty. Gasoline rationing already has materially altered motor vehicle operation in the eastern seaboard states, and the Baruch Plan to conserve the nation's civilian transportation system probably will have a similar effect upon the entire country. The recent Order 21 of the ODT restricting the operation of all commercial vehicles and buses to only essential trips and control of their movements, by requiring government certificates of war necessity before fuel, tires, tubes and accessories can be purchased is another example of further federal regulation in the interests of the war effort, and one which bears directly on the parts problem. Recent discussions in Washington on the possibility of the rationing of functional replacement parts suggest another contingency that clouds the future for the parts business.

Above all, the fortunes of war and the resultant demands of the armed forces upon raw materials, manpower and manufacturing facilities may have a decided influence upon the amount of replacement parts that are available a year hence to keep civilian motor vehicles in operation. In the year ending June 30, 1941, there were 302 representative parts plants with a sales volume of over $1 billion which reported only 1/5 of one per cent of these sales as "defense" orders. Comparable figures are not yet available for the 1941-42 period but in April, 1942, a group of 140 parts companies operating 240 plants reported to the War Production Board that 83 per cent of their shipments during that month were war goods. This compared with 78 per cent of February shipments on war products.

The same trend is evidenced among smaller groups of parts makers. One group of large representative companies with 90 per cent of their production on replacement parts during peacetime reported in June that 70.4 per cent of their output was on war work on a total man-hour basis. Seventeen smaller replacement parts manufacturers, each employing less than 100 workers, reported 63.6 per cent of their production, based on total man-hours, devoted to war contracts in June. This compared with 55.6 per cent a month previously. The 48 largest plants of original



Gaging inspection of aviation spark plugs at AC Spark Plug Division of General Motors. Aircraft spark plug demands place a burden on the facilities of the automotive industry.



Parts Outlook

Day and night, six days a week, aluminum pistons for Wright Cyclone aircraft engines flow through production lines at the Hudson plant—to the final inspection pictured here. One of these Wright airplane pistons weighs from 4.92 to 4.96 pounds, as against a total of 5.25 pounds for the eight pistons formerly used in an 8-cylinder Hudson car. Aircraft engine design, however, more than offsets this extra weight. Although the 128-horsepower Hudson-8 motor is one of the most powerful, one Wright Cyclone cylinder produces more horsepower.

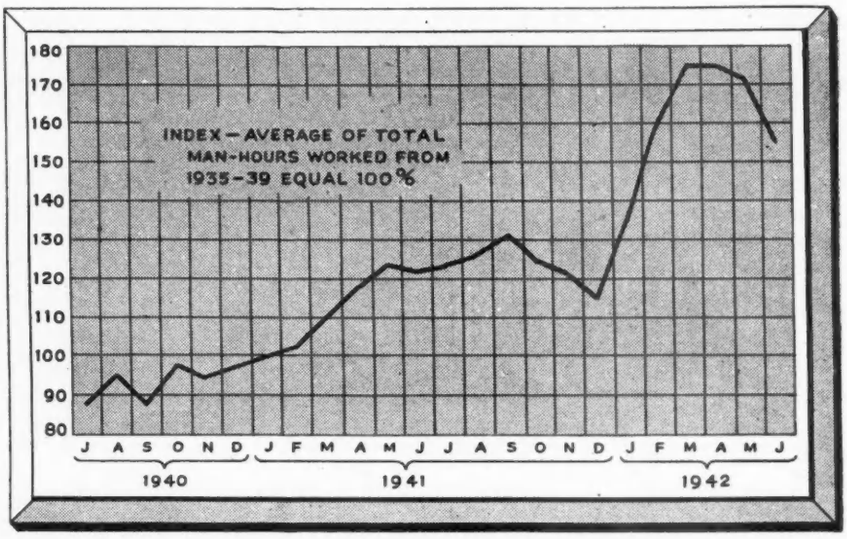
equipment manufacturers were engaged 74 per cent in war production during February but by May this had climbed to 94 per cent. Of course, the original equipment makers can aim at all-out conversion, as they do not have to conserve any substantial capacity for replacement parts for essential civilian use.

The Automotive Branch of WPB would like to keep all civilian motor vehicles in operation. The viewpoint of the Automotive Branch, as expressed by R. L. Vaniman, its chief, is that the automobile is an integral part of the U. S. economy and it is to the advantage of the conduct of the war effort to keep as many vehicles as possible running. Private transportation will help minimize the strain upon the railroads, buses and municipal transportation systems, all of which are approaching peak load conditions. Of course, the Baruch Plan will help effectuate such a condition, as motor vehicle use will be limited by nation-wide gasoline rationing, a 35 mph. speed limit, 5000 miles or less annual driving and a program of tire recapping and conservation. Failure of tires alone will eliminate many unessential motor vehicles from the road and essential vehicles needing them will be provided with recaps and retreads.



Manufacture of replacement parts first was limited by Order L-1-a and L-4, issued by OPM in September, 1941. L-4 limited production of replacement parts for passenger cars and light trucks from Sept. 15 to Dec. 31, 1941, to 60 per cent of such production in the six-month period from Jan. 1 to June 30, 1941, thus continuing the 1941 going rate of such production. Replacement parts production for medium and heavy trucks for the five months from September, 1941, through January, 1942, was limited to 100 per cent of such output in the first six months of 1941 under the provisions of L-1-a. An A-10 preference rating was granted passenger car and light truck parts, while an A-3 rating went to medium and heavy truck parts.

Amendments to Orders L-4 and L-4-a were issued Jan. 23, 1942, raising the production for the first six months of 1942 to 150 per cent of the sales volume of such parts in the entire year 1941. In effect this established a production rate three times the 1941 rate by compressing it into a six-month period. However, such production was limited to functional replacement parts necessary for the operation of motor vehicles. The order was designed to provide a two-year stockpile of replacement parts. But there was no change in the A-10 priority and most manufacturers were unable



Graph showing manufacturing activity in a group of representative replacement parts plants 90 per cent of whose normal production is replacement parts.

to obtain enough materials for such heavy parts production. There also was the problem of finding storage space for the huge amount of parts that could be made under the order. And a few companies were so heavily engaged in war work that they did not have the necessary men or machines to operate at such a high production rate.

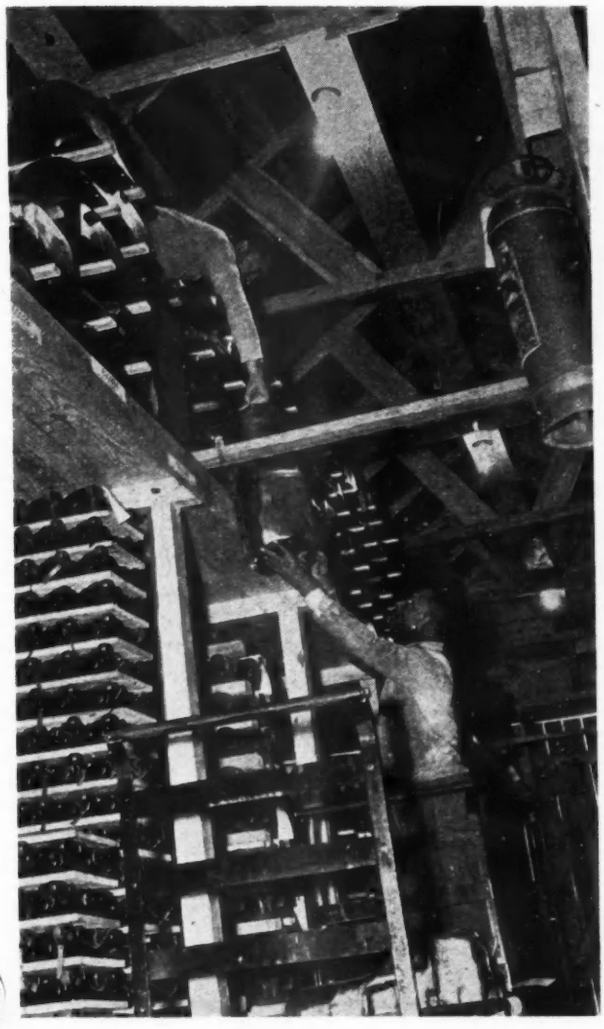
Order L-35, issued at the same time as the amendments to L-4 and L-4-a, limited the production of functional replacement parts for medium and heavy trucks for the three-month period from Jan. 1 to March 31, 1942, to 60 per cent of the sales of such parts in the six months from July 1 to Dec. 31, 1941. Then L-35 was amended on March 5, 1942, to extend the production of parts for medium and heavy trucks to the end of the year. For the six months ending June 30, producers were allowed to manufacture 75 per cent of the parts sold by them in the calendar year 1941, designated as the base period. For the nine months ending Sept. 30 they could produce 112½ per cent of their sales volume in the base period and for the 12 months of 1942 they could make 150 per cent of their 1941 sales total. The preference rating on such truck parts production also was raised from A-3 to A-2.

Recognizing the difficulty of turning out passenger car parts at three times the high 1941 production rate under war-time conditions, the Automotive Branch issued Order L-4-c on May 5, 1942. This limited production of functional replacement parts in the six months from April 1 to Sept. 30, 1942, to 70 per cent of the dollar volume of such sales in the corresponding period of 1941. It also included an inventory limitation for producers on both raw materials and finished parts in order to balance inventories. This order was more in line with the facts of the material situation but it did not improve the A-10 preference rating to get the material.

The sequence of the various parts orders is reflected in the production record of a group of replacement parts manufacturers. Taking the 1935-39 average production on a total man-hour basis as 100 per cent, these companies were operating at a rate of 86 per cent on Jan. 1, 1941. By June 1 the rate had climbed to 121 per cent. The parts production reached a peak of 131 per cent on Oct. 1, 1941, but had dropped to 114 per cent by Jan. 1, 1942. With parts output boosted to three times the 1941 rate of parts production by Orders L-4 and L-4-a, the rate climbed to 159 per cent on March 1 and to 174 per cent by April 1, 1942. Increasing diversion of facilities to war work was partly responsible for the big increase but theoretically the rate for replacement parts output alone could have jumped to



Checking gears for transfer cases of army trucks at Chevrolet Motor Division plant at Toledo, O. Demand for gears for military vehicles and aircraft engines puts a strain upon the gear cutting capacity of the automotive industry.



The Army is the biggest purchaser of automotive replacement parts. A scene in the warehouse of the Fort Wayne Ordnance Motor Supply Depot at Detroit shows stocks of spare parts for army vehicles, which will be shipped out upon requisition.

300 per cent. Materials and machines were limiting factors. With parts production cut by L-4-c, the index dropped to 155 per cent on July 1, 1942, the latest figure available.

Latest limitation order affecting replacement parts is L-158, issued July 4 and extending such production to the end of 1942. Superseding Orders L-35 and L-4, L-158 limits production of parts for passenger cars and light trucks in the third and fourth quarters of 1942 to 70 per cent of the dollar value of such sales in the corresponding quarters of 1941, unless more than a four-month inventory is on hand. In the latter case, production is restricted to 50 per cent of sales in the corresponding period of 1941. Producers of parts for medium and heavy trucks can produce up to 125 per cent of such sales in the corresponding quarters of 1941 unless having a four-month inventory on hand, in which case their output is limited to 75 per cent of the base period.

Although no higher priority rating for materials was granted by the new order, the Automotive Branch issued a directive allowing preference ratings up to A-1-a to be assigned on PRP applications. Amendment No. 1 to L-158, issued Aug. 1, allowed manufacturers to schedule all their replacement parts production as A-1-a. This was altered Sept. 1 by allowing the scheduling of such production as if bearing an AA-2-x rating, which is the highest civilian rating obtainable and is superseded only by the special AAA classification and the AA-1 and AA-2 groups, all of which are reserved for military and lend-lease purposes. This elevation of the preference rating is indicative of the government's favorable attitude towards keeping civilian transportation on the road.



L-158 is regarded as a very practical order which is realistic in its approach to the parts situation. Some complaint has been registered by distributors, especially new car dealers, over the provision requiring that a compliance certificate accompany each parts order. Many dealers have a difficult time obtaining clerical help to handle all the paper work that governmental regulations require. Their operating costs are increasing, while the volume of business is on the decline. This is one more order to add to the burden but it must be regarded as one of the hardships of war-time.

The provision requiring the turn-in of a used part for every new part purchased is designed to prevent hoarding by individuals and to keep the used parts flowing back through authorized scrap channels.

So far the number of cars and trucks immobilized for lack of parts compared to usual peace-time conditions has not been large. Some passenger cars have been laid up temporarily for want of a replacement part, such as a water pump, but the total is scarcely any larger than under normal conditions. Chief hindrance to keeping passenger cars in repair has not been lack of parts but lack of manpower. Dealers and service establishments are finding it increasingly more difficult to retain competent mechanics. Between the demands of the armed forces and the incentive of higher wages in war industry, it is more and more of a problem to keep trained and experienced mechanics in repair shops. Automobile companies and school systems are endeavoring to train more men and even women to fill the growing vacancies in the service field but the demand for skilled mechanics in this war on wheels appears inexhaustible.

The parts problem is a little more serious in the truck field. Some manufacturers of original equipment shifted these facilities to replacement parts when the production of new cars and trucks was halted last February. This expanded capacity, especially in the truck field, has enabled the supply of some parts to keep abreast of the increased demand.

Due to the huge military truck requirements which compete with civilian needs, there has been a scarcity

(*Turn to page* 264, *please*)

Production Short Cuts

TEN years ago the annual production of airplanes in the United States amounted to a little over 1100 planes, a few thousand workers built them and their dollar value was in the millions. How vastly different now with annual production many thousands, the number of employes totaling hundreds of thousands and the dollar value in the billions. But the skyrocketing to these unprecedented heights has been jammed into the past three years with the result that the aircraft industry has had to expand its manufacuring facilities at a tremendous pace. It entered an uncharted field—the mass production of warplanes and in the midst of a highly competitive military race.

In this short period such rapid growth entailed many complex problems, a major one the equipping of plants. Manufacturing practices had to be discarded in favor of volume production techniques, which made necessary the development of many new machines of high productive capacity and handling equipment incorporating the latest design features.

As plants swung into production, schedules were boosted higher and their production engineers had to find ways of raising the output rates to meet them. Special machines were needed in some cases, old machines had to be converted to do the work of machine tools difficult to obtain, while in others manufacturing operations were revised to speed the flow of materials, parts and assemblies. Many thousands of tools, including intricate jigs and fixtures, have been introduced advantageously to effect production short cuts. One company estimates that since the war emergency it has designed and built nearly 100,000 special tools of all kinds and classifications, not including any of the standard types of tools purchased, such as electric drills, pneumatic hammers, riveting and welding ma-

Lockheed-Vega





(Center) Fatigue has been reduced for crew members and production increased by at least 25 per cent by portable, knock-down stock tables with corners cut out to provide more working space for loading and unloading the circular beds of the hydraulic presses.

(Left) Lockheed engineers developed this high speed miller for facing of P-38 wing fittings so that the work can be done rapidly while the wing is being made on the assembly line. Long guides on each side of the corrugated fitting hold the bracket attached on the 50,000 rpm air-driven Onsrud motor.



(Right) Welders at the Lockheed plant work on small parts for P-38 interceptors and Hudson bombers by clamping them to turntables which they rotate with their feet. Automatic torch lighters also are provided to facilitate their work. The main gas lines are equipped with water traps to prevent fire in case of gas backfire.

Cuts at Aircraft Plants

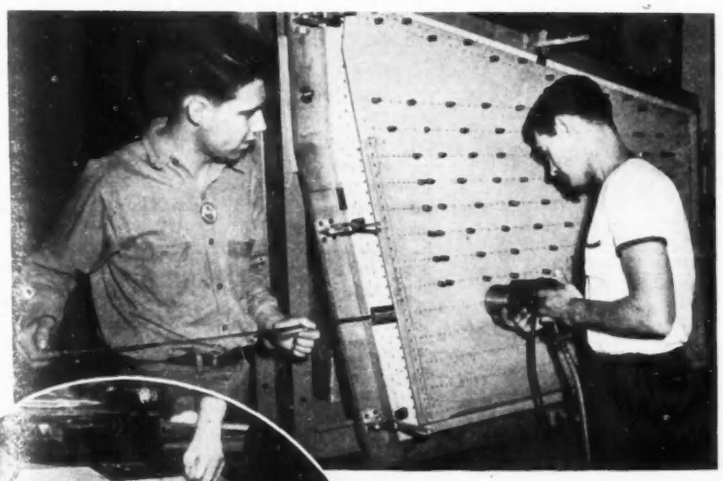


By
James R. Custer

chines, large presses, dies, metal cutting machines and countless other tools used in production.

It has been these production short cuts that have contributed in a large measure to the continually growing production rate of American warplanes. Many ingenious devices are to be found in the factories. There are such developments as a standard keyseater converted to do the work that formerly was done by a vertical shaping machine with a rotary table and production increased 40 per cent, a hydropunch that performs 19 different punching operations at one time and turns out work 45 times more rapidly than the machine it replaced, a test panel for testing the wiring of a bomber that reduces the time from 4½ hours to 17 minutes, a new method for removing broken drills, reamers and gages from drilled holes, saving both time and the parts, a "caterpillar" boring bar for machining hydraulic parts that reduces the number of operations and the man-hours by 25 per cent, an automatic machine for milling wing cap strips at an almost 90 per cent saving of time, a "heat therapy" system for preventing the wrinkling and buckling of the skin on metal wings, and a single drill that does in one operation what formerly required three separate drills.

These production short cuts and other typical examples selected from the thousands that have been introduced at plants of various companies in the American aircraft industry are displayed in this pictorial presentation to be published in two installments, the first on these two pages and the following eight pages. The second installment, which will consist of production short cuts at Consolidated, Goodyear, Timm and North American aircraft plants, will be published in an early issue of AUTOMOTIVE and AVIATION INDUSTRIES.





(Circle) Holsters for drills have helped speed drilling operations at the Vega plant and also are credited with preventing much drill and bit breakage.

(Left) This magnetic riveting device has been of tremendous value in speeding the production of P-38 fighters. It magnetizes a bucking bar, which is drawn through narrow channels by a wire as illustrated, pulling it firmly against the rivet at the moment the riveter presses the trigger of the gun. This ingenious invention won the $2,500 Revere Award for William Holcomb, Lockheed assistant superintendent of new development, as the most noteworthy device to speed production in the aircraft industry.

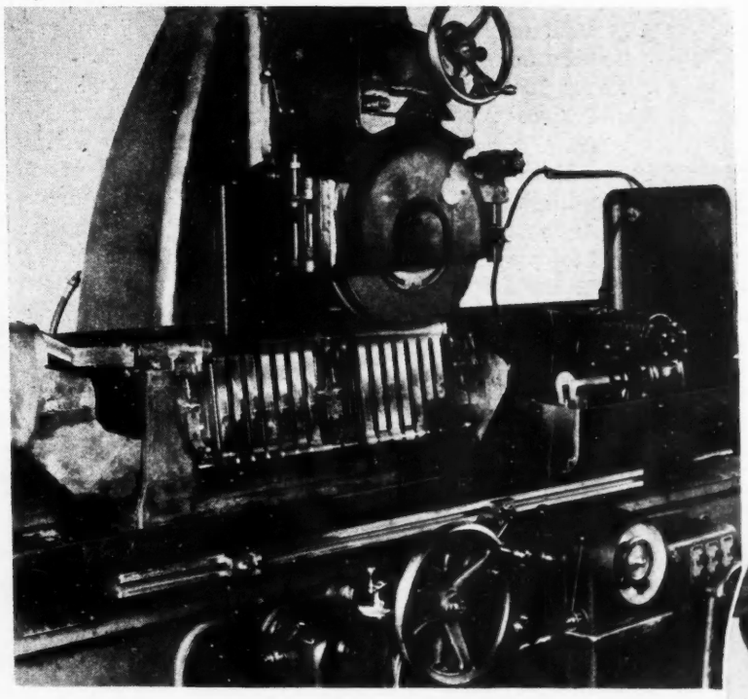


(Right) Slanting benches are used at the Vega plant to speed drilling operations on parts for Flying Fortress and Ventura bombers.

Wright

Production

Short

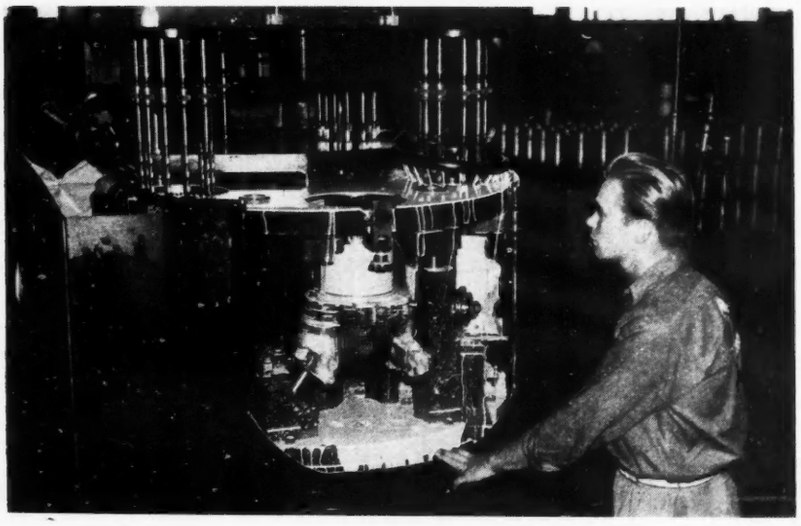


(Above) The round ends of articulated rods formerly were ground on a disc grinder by oscillating them manually about a pin on the grinder table. With the present set-up, the rods are loaded seven at a time on special arbors which fit into both the upper and lower end holes. Two arbor loads are then placed in a special, power-driven oscillating fixture on the table of a Mattison grinder equipped with a wheel dressed to a deep concave radius. As the work table travels back and forth under the wheel, the rods are rotated through an arc, thus assuring absolute concentricity of the inside and outside diameters. When the operation is complete, the arbors and rods are transferred to a second machine on which the opposite end is similarly ground to a different radius. Not only is production thus substantially increased but the parts require less polishing than formerly, and are even more accurate.



(Circle) The operation of back-spotfacing and chamfering bronze spark plug inserts in cylinder heads originally was performed at the Wright aircraft engine plant on a standard back-spotfacer and necessitated considerable skill on the part of the operator. A special Snyder machine now cuts both inserts simultaneously in 1/12 of the time previously required.

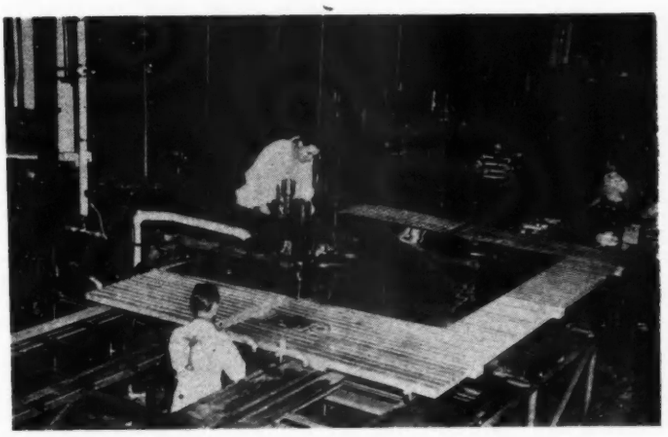
(Below) Multiple spindle machines naturally play an important part in a high speed production program, as exemplified by a special 40-spindle Baker drill used to drill, ream, and countersink the twenty holes in the flange of Wright cylinder barrels. The machine is equipped with an automatic, five-position index.



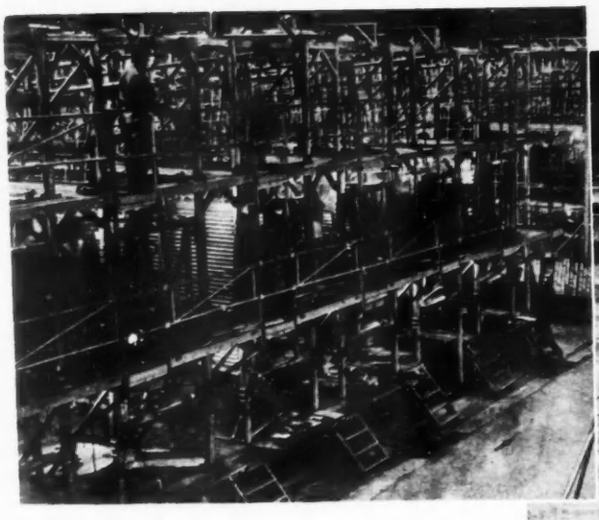


Cuts at Aircraft Plants

Boeing



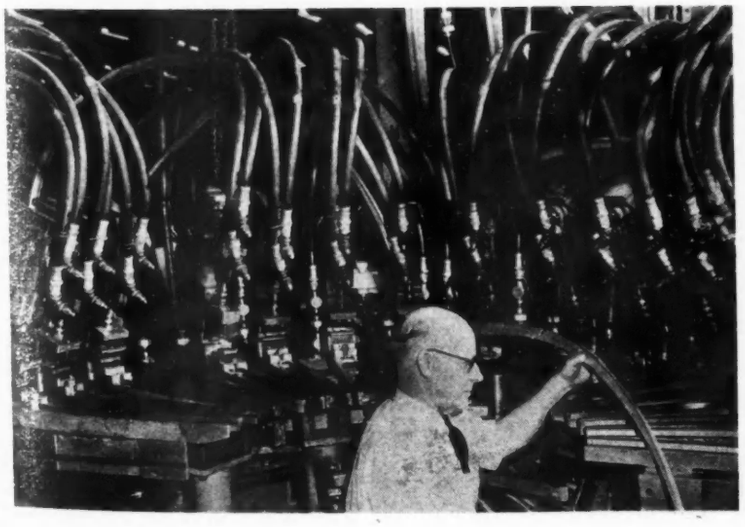
(Right) Boeing engineers designed this high speed automatic spot welding table to make 62 welds per minute, the table pausing one-half second for each welding operation. Indexing plates are provided to make adjustments for governing the spacing of the welds. The work is held by electro-magnetic clamping bars. Only one man is needed to operate the machine, as the table moves automatically and the welding points move in synchronization with it. The worker with his back to the camera is a maintenance man who services a battery of six machines in the plant.





(Above) Flying Fortress wings are built upright in batteries of three-story jigs.

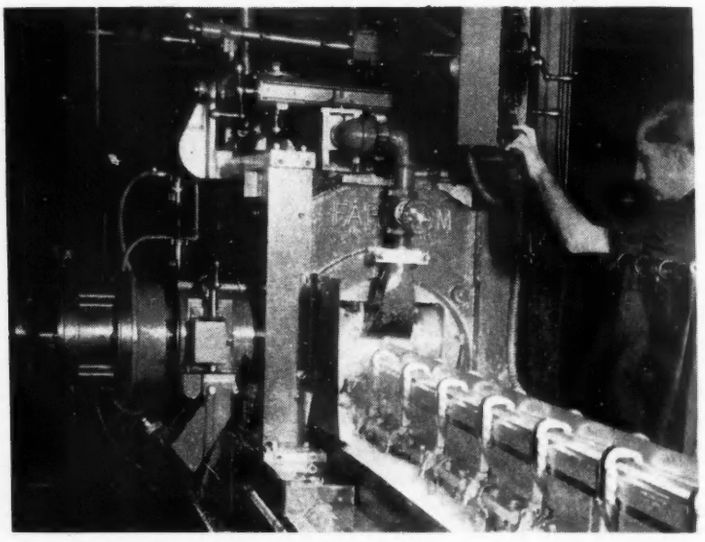
(Above) Boeing has originated the "Production Density" system to obtain the most efficient and greatest possible use of its manufacturing facilities. Assembly operations and the flow of parts are concentrated so that the plant is a compact integrated unit. The final assembly line is very short, with seven major assemblies for a Flying Fortress feeding to the final assembly fixture where the plane is completed. Sub-assemblies also are laid out to provide compactness. This view shows the major assembly rows of main fuselage sections.

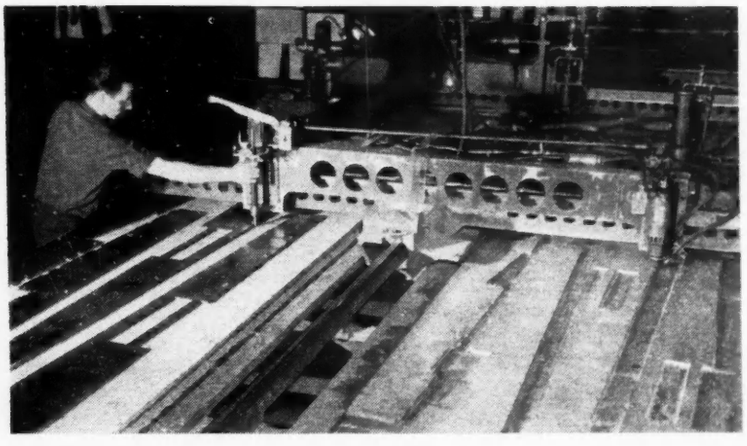


(Left) Boeing's tooling department developed this circumferential hydropunch for making V-type slots in the circumferental stiffeners for Fortress fuselages. It performs 19 different punching operations at one time and turns out work 45 times faster than the machine it replaced.

Bell

Production Short

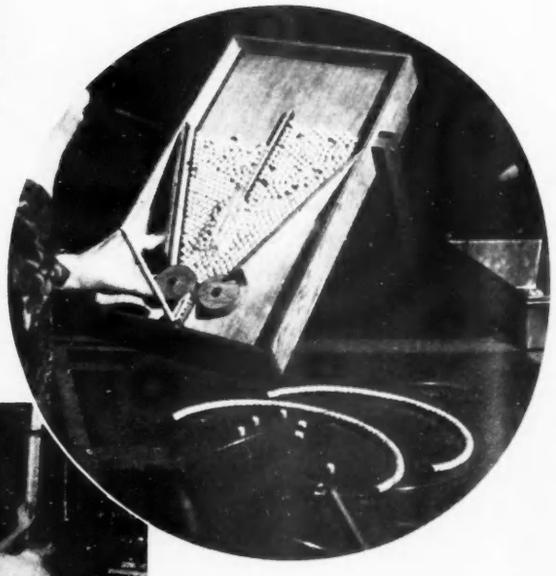


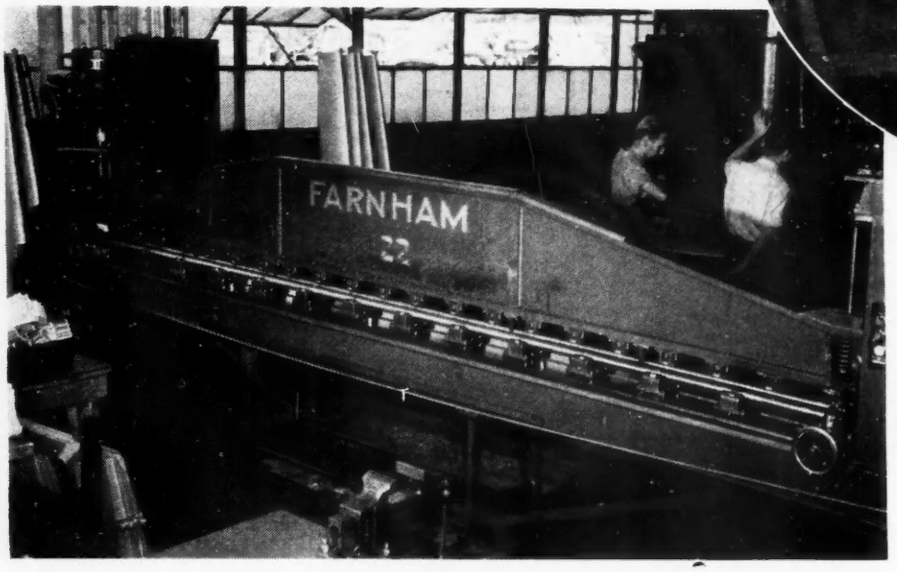


(Above) This automatic milling machine, developed by Bell engineers and now being built by the Farnham Mfg. Co., mills the cap strips for Army P-39 Airacobra wing beams at almost 90 per cent saving of time over former methods. Angle profile can be cut by more than 80 per cent. Moving down the length of the beam, which is fastened to a stationary base, the miller trims the excess aluminum away from the extrusion at speeds as high as 40 inches per min.

(Above) Complicated parts can be cut out quickly and cheaply with this Bell pantograph router, including as many as a dozen at one time. Rivet holes also can be pattern-drilled by this machine.

(Below) Tapered leading edges for wings are formed at a reasonable cost on this leading edge rolling machine, which has giant micrometers at each end to make rapid adustments easy.

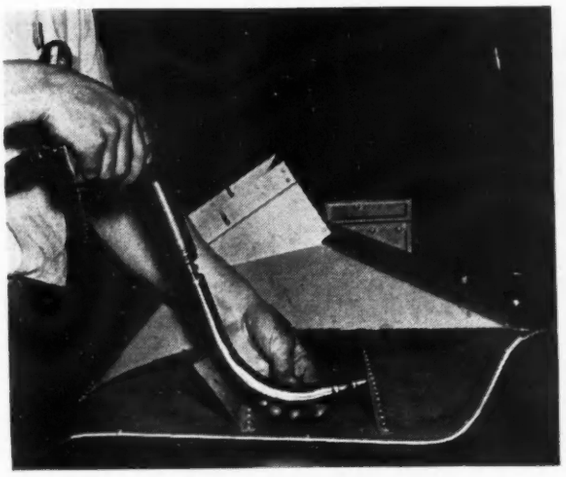




(Circle) Large quantities of beads are used to insulate the antenna leads connecting the aerial with the radio equipment, so this "rapid beader" device was built to provide a much faster and easier method of aligning beads for stringing. Other devices now used at the Bell plant are a pressure testing coupling for hose or tubes, which makes it possible to test 65 assemblies an hour as compared to 15 previously, and a cable prestretcher that eliminates the need for undue take-ups in the field.

Cuts at Aircraft Plants

Martin



This bent peen for use in cramped places saves time.

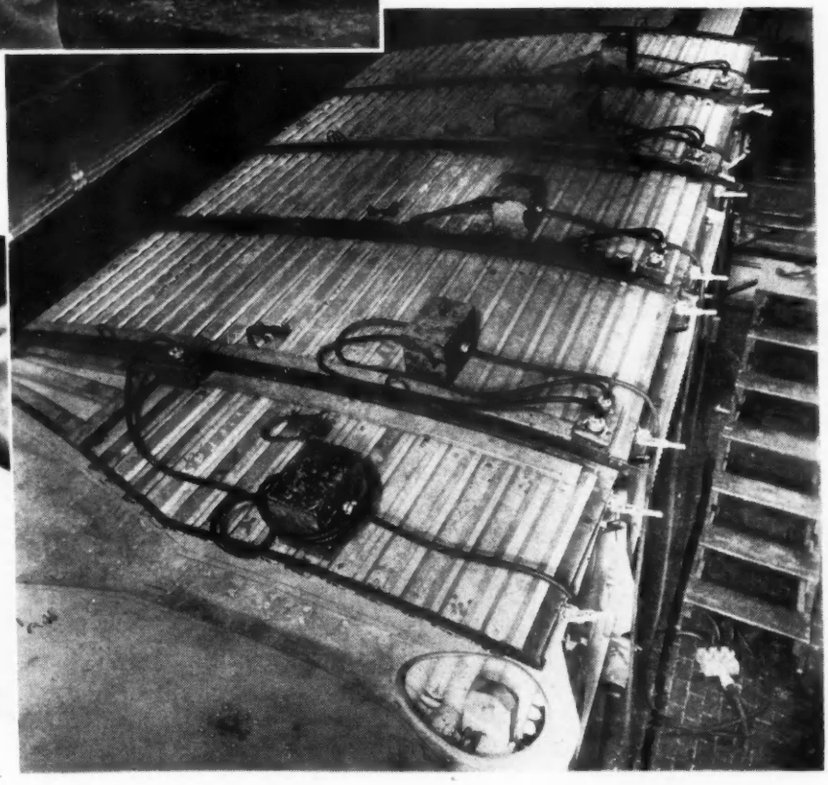


(Below) At the Glenn L. Martin plant a system of "heat therapy" is used that does away with the wrinkling and buckling of skins that ordinarily results from the pounding of the hammers when riveting aluminum skins to wing spars and ribs. Skin heaters are laid on top of the skin and the electric current turned on. In a few minutes the skin has a temperature of 140 deg. and while the temperature is held constant, the skin is stitch-riveted quickly round the edges and along the ribs. The heaters then are removed and the skin shrinks taut.

(Right) This single drill does the same job in one operation that formerly required three separate drills for reaming, spot-facing and countersinking holes for Dzus fasteners.

(Below) A power-driven tool for filing hood cowlings. Now four cowlings can be filed in same time that was required for one.



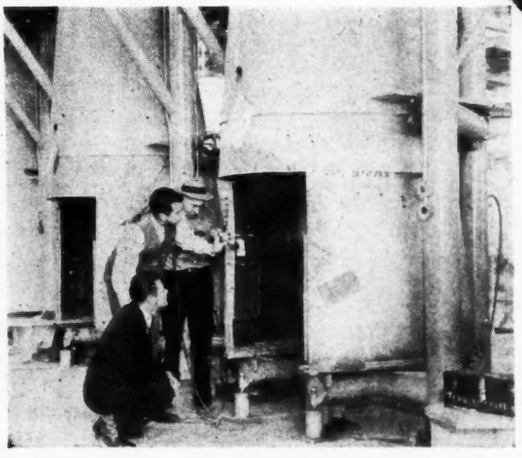


Production Short

Vultee

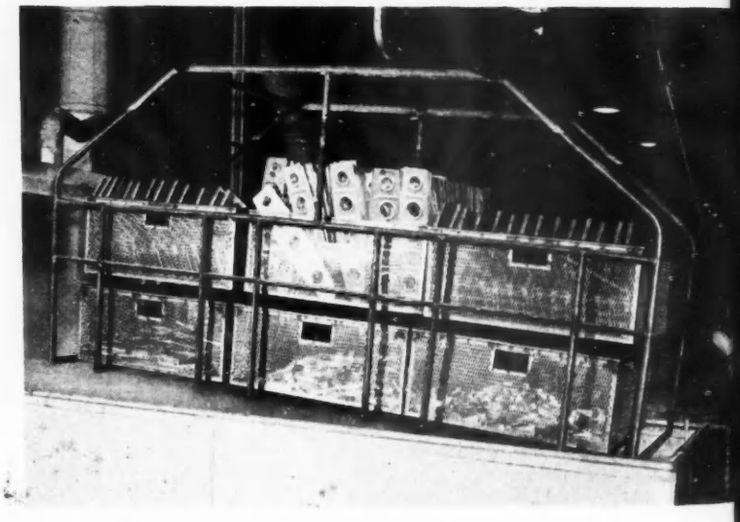


(Circle) Push rod controls are assembled at Vultee's Nashville factory by this bench method to reduce space and at the same time to provide a convenient arrangement of parts and attachments. Using an air-driven socket wrench, the operator completes assemblies at a much higher rate than formerly.



(Above) At the Nashville Division of Vultee Aircraft an innovation in the plant's production system is a series of vertical fuselage jigs. The vertical position enables workers inside the fuselage to apply their full effort, conserves factory floor space and reduces the distance fuselages must be moved from one stage to the next.

(Below) Lowering six baskets at a time into the chromic acid cleansing tank.



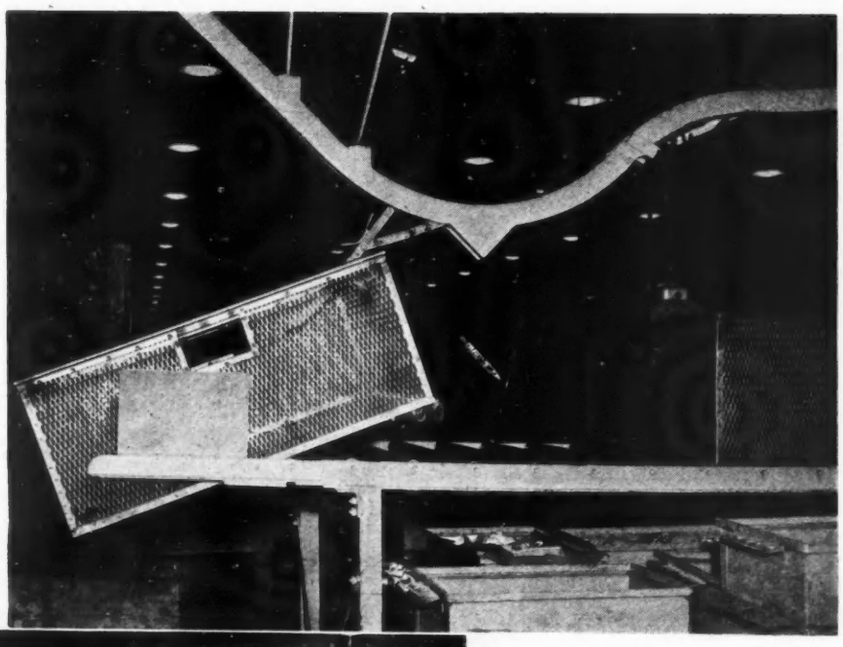
AN INNOVATION at the Vultee plant is a new type of conveyor for mechanical handling of all sheet metal parts from inspection to the prime paint conveyor line. The entire process, which is continuous and reduces the handling of parts from five times to only twice, not only eliminates unnecessary handling, but also increases the capacity of the chromic acid tanks by at least 100 per cent.

With this new system, inspectors remove completed sheet metal parts from the skids, test them and pass them across a bench to the inspection stamp operator, who then places them in special metal baskets. Weight of the loaded baskets causes them to roll by gravity conveyor to a central point, from which an overhead crane picks up six of them at a time and handles them throughout the operations in the cleansing tanks.

Instead of the parts being unloaded after cleaning, they remain in the baskets, which are deposited by the overhead crane on a roller conveyor adjacent to the prime paint line. They roll by gravity to appropriate stations, from which they are sidetracked by a mechanical device which puts them in convenient position for efficient transfer of the sheet metal parts to the moving primer line.

Gravity carries the empty baskets from the sidetracking device to a lower section of the roller conveyor, on which they travel to the point at which an automatic chain conveyor dips down to pick them up and carry them back, overhead, to the main sheet metal inspection station. There, an automatic trip releases the empty baskets in position to receive a new load of parts.

Cuts at Aircraft Plants



(Above) empty basket being returned to the main sheet metal inspection station.



(Left) Basket of parts, each bearing inspector's okay, being sent on its way to the overhead electric crane.

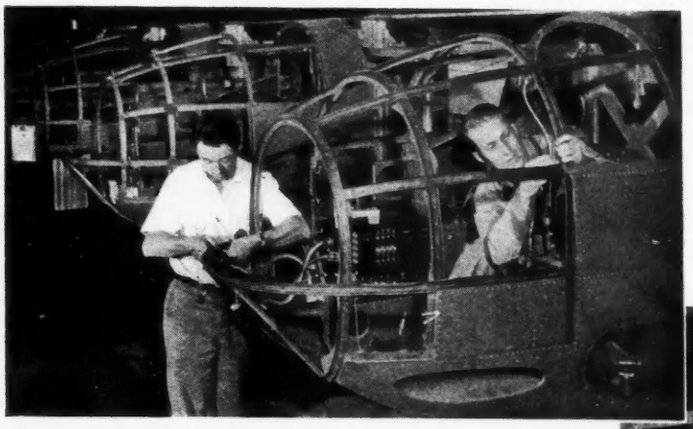
(Below) Transferring parts to the swivelled trays of the powered paint line.



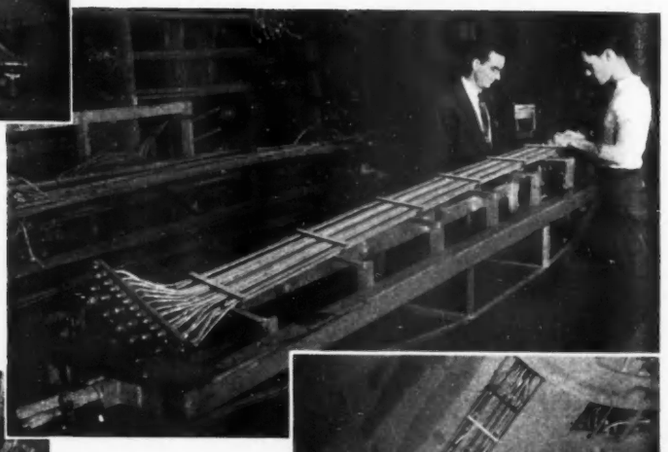


Douglas

Production Short



(Left) On this "vertical" assembly line for the production of nose sections for Douglas attack bombers, the units move along in the same position they will have on the aircraft and at the same time are accessible at all sides.

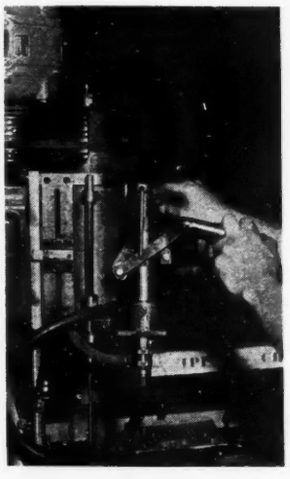


(Right) Instead of installing individual lines and fittings in the airplane itself, the operation is speeded by assembling whole systems in special jigs in advance, then placing the entire units in the airplane.



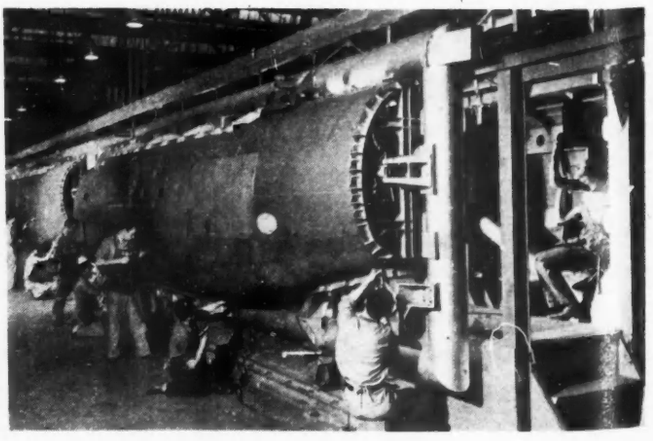


(Left) Production illustrative drawings are supplied to assembly line workers. They particularly help new workers who just are entering the aircraft field. Workers also find them quite useful when starting on new operations.



(Left) By supplying controlled air pressure with a special regulator that prevents vibration, it was possible to eliminate nine different valves, six switches, an air gage and several other fittings on this machine. Drill breakage was reduced by 90 per cent and now three holes can be drilled to one previously.

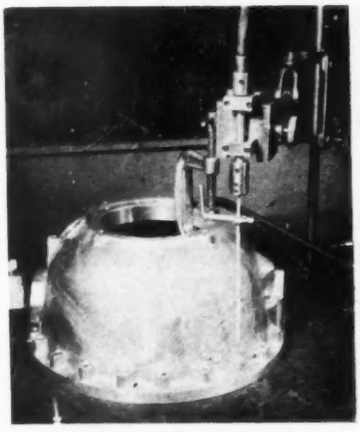
(Right) Douglas engineers developed this mechanized line to speed the production of bomber fuselages.



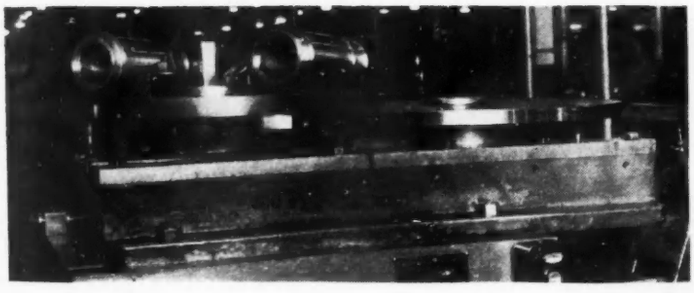
Cuts at Aircraft Plants



United Aircraft

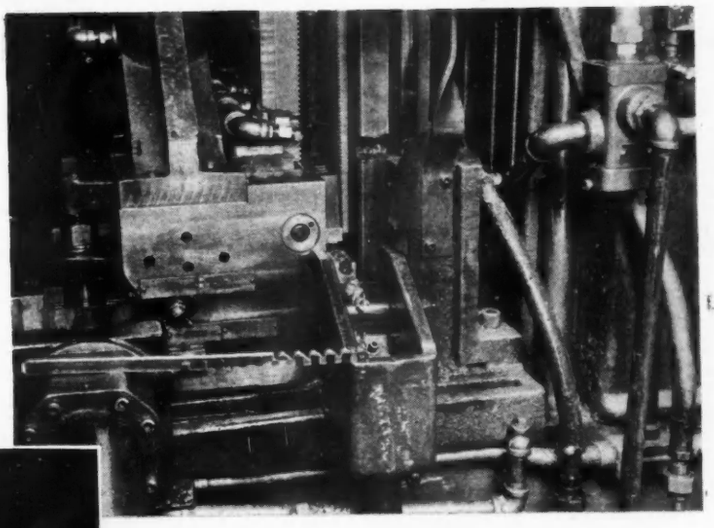


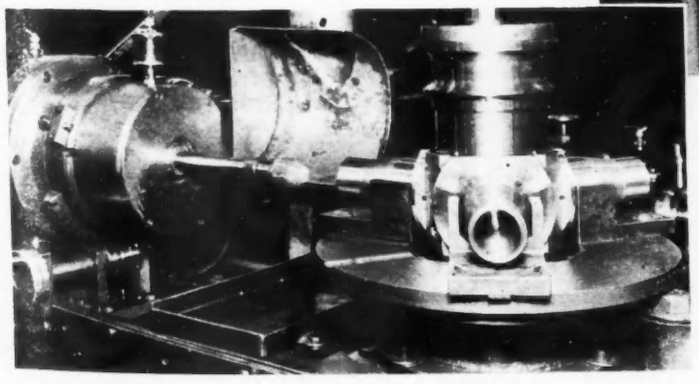
(Right) For the removal of broken drills, reamers and plug gauges from drilled holes, Pratt & Whitney's production engineering department has developed a method of making an electric arc butt-weld between a stainless steel welding rod and the broken part, and then extracting the latter by tapping upward on a lathe dog or clamp on the welding rod. Not only are more parts being saved from the scrap pile, but the time of the salvage operation is considerably less. It is being used on engine crankcases, crankshafts, propeller shafts, various small parts, tools, jigs and fixtures.



(Left) On Hamilton Standard controllable pitch propellers a hex is generated into the piston, which serves as a combination piston and propeller retaining nut. This hex permits the use of a wrench in adjusting the part. When a verical shaping machine with a rotary table became difficult to obtain, a Morton keyseater was converted into an automatic machine for this purpose by the construction of special fixtures, utilizing a Geneva motion with a cam arrangement. This simplification eliminated the need of a skilled operator, conserved floor space, provided an 80 per cent saving in labor and increased production 40 per cent.

(Right) To provide an automatic machine for turning out thousands of spring pack retainers for the controllable pitch mechanism, Hamilton Standard production engineers adapted a self-fed LaPointe broach for making them from standard rectangular barstock. Now three operations are performed simultaneously and at each stroke of the machine three complete units are ejected. The cost per unit was reduced 75 per cent. Originally they were made from extruded bar stock, which was first milled through the center, broached, then parted to the proper size, and the outer surfaces ground to a close tolerance.





(Left) This special eccentric polishing head saves more than two-thirds the time previously required in polishing spider arm bores for Hamilton Standard propellers. Cams are used to provide eccentricity. Incorporation of a work holder and a feed mechanism made the machine semi-automatic and a special bob was designed to form the radii at the bottom of the arm bore. Previously the operations were performed with a turret lathe.



Tooling Up

LONG before the automotive industry was faced with the necessity of converting all its plants completely to war production, the defense requirements of what are now the Allied nations imposed upon America's machine-tool industry a fantastic demand for increased output of metal-working equipment.

Machine tools cannot be built over night; yet they were needed immediately—and needed in quantities that dwarfed anything the industry had ever previously been called upon to produce.

Thousands of existing metal-working plants had to be expanded. Thousands of new plants had to be tooled from the ground up with new equipment. And whole industries, such as the aircraft engine industry, had to be converted from small-lot production requiring general-purpose machine tools to mass production requiring specially-designed single-purpose machines.

The industry's response to this seemingly impossible task is shown graphically in the accompanying chart.

In studying this chart your attention is called to the use of the dollar volume figures. Readers of AUTOMOTIVE AND AVIATION INDUSTRIES are probably more familiar with the use of unit figures than they are with dollar volume figures in connection with the accomplishments of an industry, because the automotive industry has always talked in terms of units. In pre-war days unit figures presented a fairly accurate measurement of motor car production—the finished product was for the most part either a passenger car or a truck.

As of today, however, neither a unit figure nor a dollar volume figure covering production of the automobile industry possesses any such significance. Automotive companies are now making, in addition to cars and trucks, hundreds of different items from tiny bullet clips to 28-ton tanks. A dollar figure would represent volume in terms of money, but would hardly give a clue as to the full size and scope of the industry's gigantic and varied operations.

I make this point by way of introducing the machine tool production figures because there are well over 250 different kinds of machine tools, and various types of each kind. In size, machine tools may range from that of a small desk to that of a three-story house. In cost they may range from a few hundred dollars to over

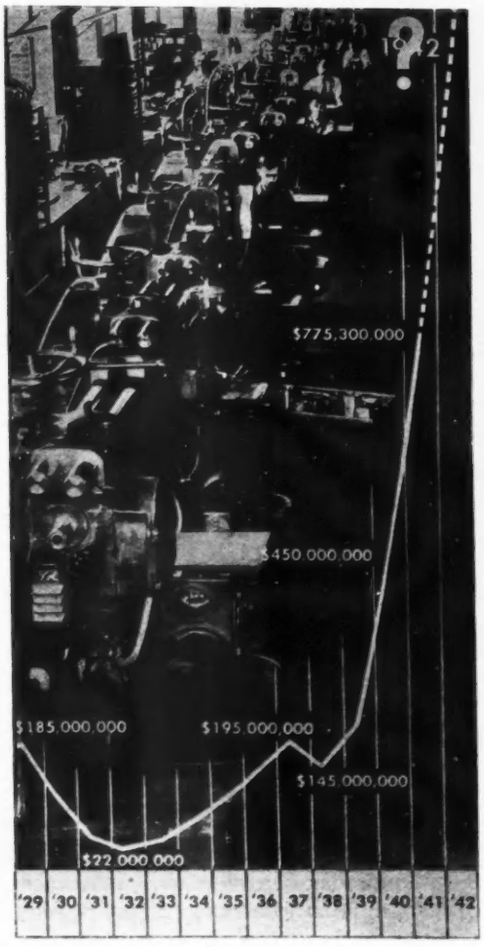


Without machines that work to extremely close limits and in many instances perform a number of operations, the record-breaking schedules for war production could not be met. Here is a precision boring machine finishing aluminum crank case spacers for airplane engines. In this one setup, the part is turned on the outside diameter, rough and finish faced and chamfered.

for Victory

Automotive, Aircraft, and Machine Tool Industries Join in a Triple Offensive

By George H. Johnson
President, National Machine Tool Builders' Association



Production of machine tools, which reached a depression low of $22,000,000 in 1932, was skyrocketed to $775,000,000 last year. Production in the first six months of this year has been averaging more than one and one-half times what it was in the same months last year. The machine tool industry, says Major General Echols, in charge of material for the U. S. Army Air Forces, "has done a magnificent work in enabling the aircraft industry to meet production schedules set by the Government."

a quarter of a million dollars per unit.

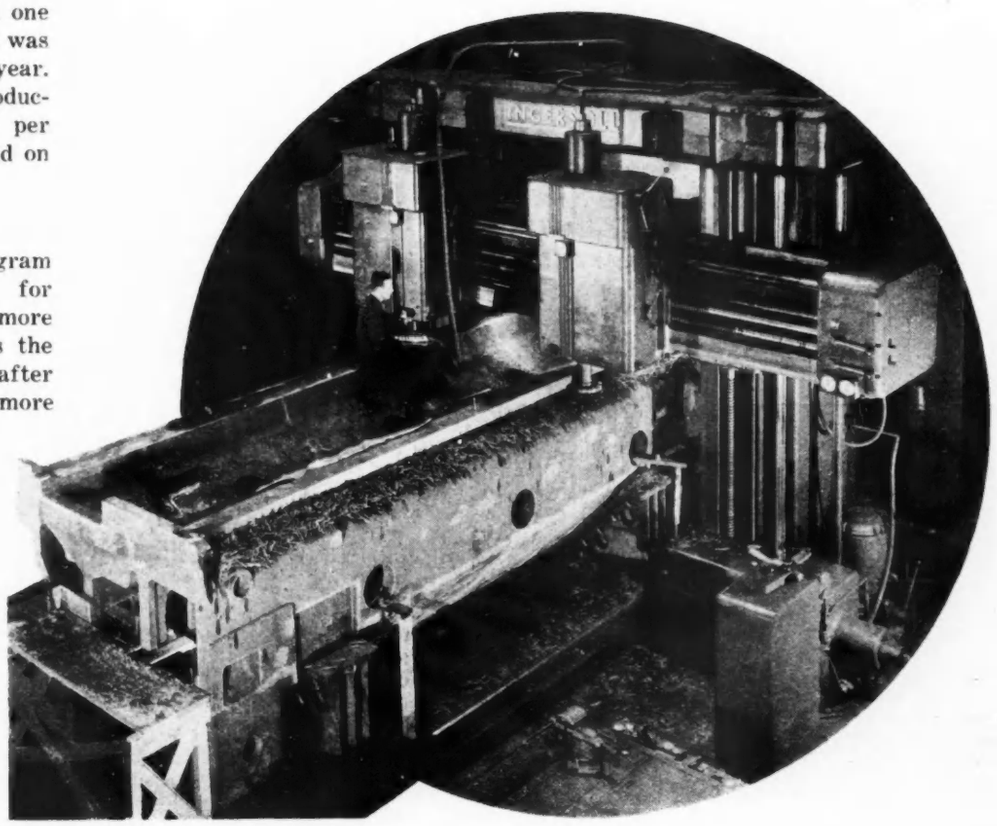
Therefore, the dollar volume figure of total machine tool production is simply an overall indicator of volume of business done, and does not in itself tell the whole story any more than such a figure today would tell the whole story of war production in the automotive field.

You will note that last year machine tool output reached $775,000,000. Yet in the first six months of this year it has been averaging more than one and one-half times what it was in the same months last year.

The industry is now producing more machine tools per month than it used to build on the average in a year.

Sales Engineering

With every new program planned in Washington for more planes, more guns, more ships and more tanks, as the Axis ravaged country after country, the demands for more



Machine tools may vary in size from that of a small desk to that of a three-story house. Here is a planer-type milling machine that can handle work eight feet high, nine feet wide and thirty-four feet long. The huge casting shown being machined weighs 35 tons. The machine itself weighs 206 tons.

machine tools skyrocketed higher and higher.

But it takes months to build a machine tool. Most of them have to be custom-built. Even with the total demand practically unlimited, machine tool builders did not receive enough orders of any one type or model to make it possible to put their own plants on a full mass-production basis.



In this emergency it was up to our industry to see to it, insofar as possible, that every machine produced to do a certain job was designed and built to do that particular job well—and also to see to it, insofar as possible, that every existing machine tool, no matter how old, was adapted to some type of war work and tooled up for maximum productivity.

This was a job of sales engineering.

It was up to machine tool salesmen to find out exactly what each customer's needs were—and then to meet those needs either with new machine tools as soon as possible, or with a plan for adapting or converting existing machine tools to war work.

Especially interesting were the means by which this second objective was accomplished.

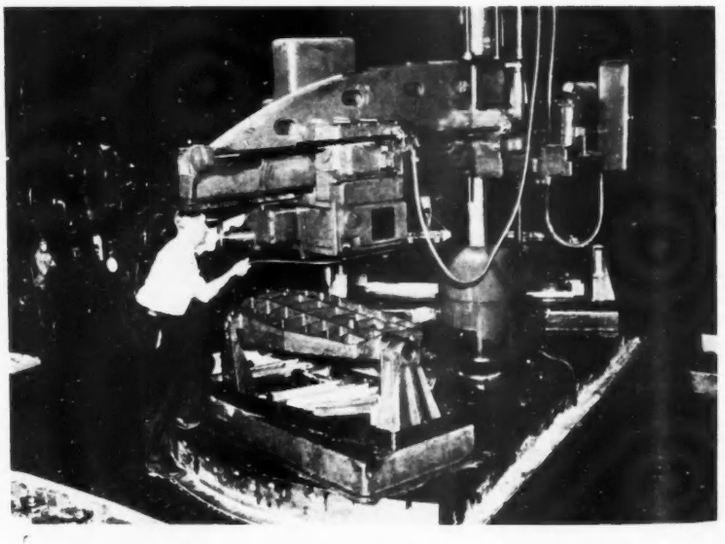
In hundreds of cases existing machines were converted from peacetime to war-production by the use of new tooling equipment suggested by sales-engineering departments. Tooling equipment has been developed over the years by machine tool builders to make their machines as flexible and as adaptable to a wide variety of work as possible. But the production department of many a metal-working plant, not faced with the problem of retooling their equipment very often, needed the manufacturer's help in order to fully adapt these tools to their own conversion needs.

In the same way, old machines of last war vintage, and even older, that many thought could not be converted to present-day war production, requiring as it does precision limits, were saved from the scrap heap after a suggested reconditioning and ingenious re-tooling by sales engineers.

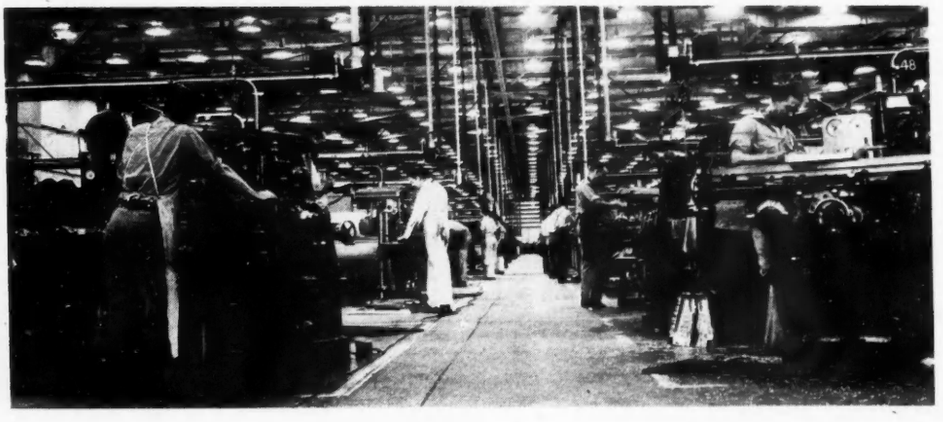
One particularly interesting activity of our sales force was that of actually trying to secure cancellations. If one company ordered more machine tools than it needed, some other company had to go without. Therefore, our sales engineers did their best to find out exactly what every company's requirements were, if they were ordering more machine tools than were actually required, to get cancellations accordingly.

It is certainly unnecessary for me to go into detail with anybody in the automotive industry on the conversion of machine tools from peacetime work to wartime work. I do, however, wish to emphasize that we in our industry felt it was just as much a part of our job to contribute engineering brains to this conversion problem as it was a part of our job to build new machine tools.

As far as our industry is concerned, "selling" today is not a matter of persuading a customer to make a purchase. Today "selling" is bringing to the customer as much helpful information as possible and showing him how to make the most productive use of his equipment. Our sales engineers and machine tool dealers

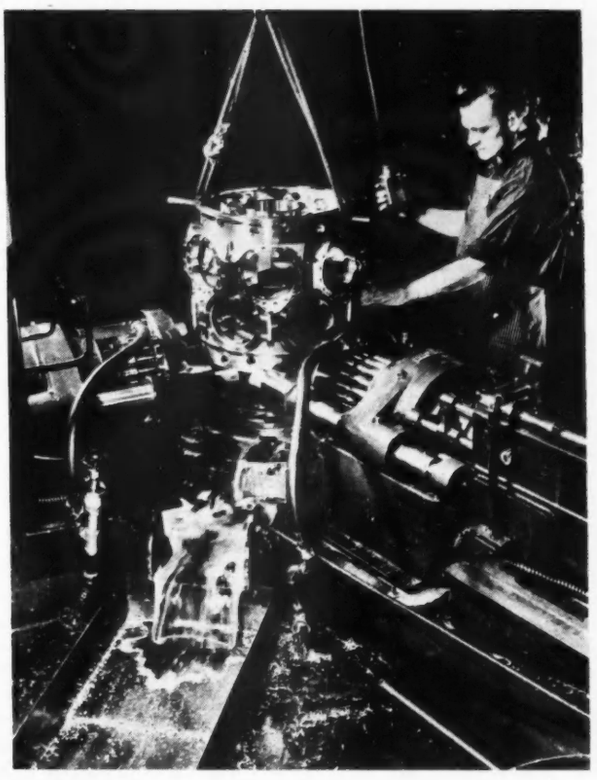


A radial drill press at the Ford Willow Run bomber plant. By means of the boat-shaped jig, this machine is used to drill and ream 112 holes in wing splices.



More machine tools are being built today for production of planes than for any other single product. The industry is now producing in a single month as many machines as it used to build on an average in a whole year. At the left is a scene in the machine shop of the Long Beach plant of the Douglas Aircraft Corporation.

One of the most difficult and important assignments given the machine tool industry was the design and building of hundreds of special-purpose machines needed to convert the aircraft engine industry from small-lot to mass production. At the right is a specially designed machine which drills, countersinks and spotfaces 224 identical 3/8-inch holes in an aluminum airplane engine crank case. It works simultaneously on 32 holes from two different directions. These operations previously required three machines and took two hours twelve minutes. This one machine now completes the job in 23 minutes.



have thus become production engineers, and are a vital part of our war effort.

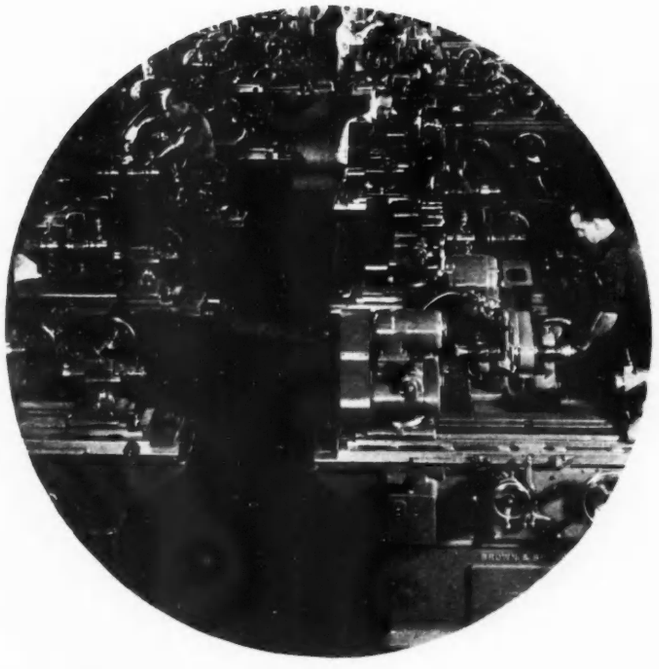
Contrasting Production Problems

To anyone outside the machine tool industry it might be assumed that stepping up machine tool output meant simply building more and more of the same product. Let me say again, this is most emphatically not the case.

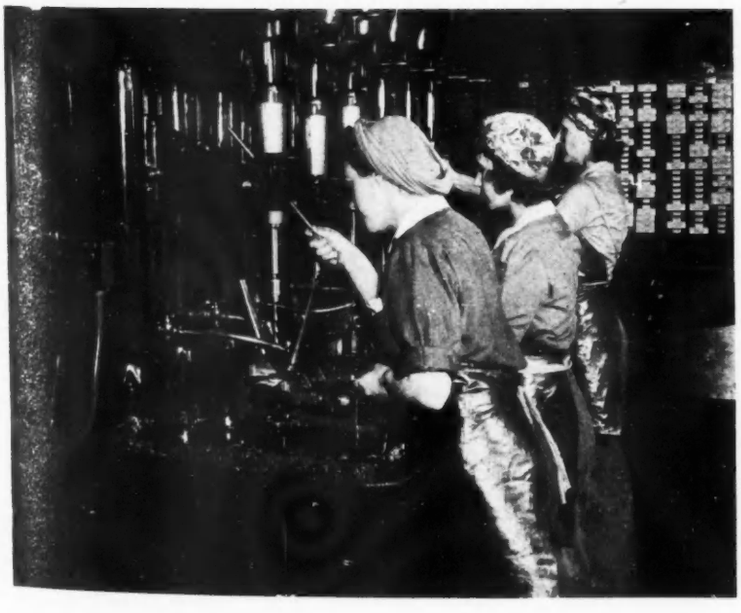
There are, in the main, two general types of machine tools required for war production.

The first consists of standard, multi-purpose machines of well-established designs. In this classification are included, for example, engine and toolroom lathes, single-spindle drilling machines, shapers, radial drilling machines, and so on.

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(Circle)—
It is somewhat of a paradox that although machine tools are the very basis of mass production, the principle of mass production can be used only to a limited extent in their manufacture. Most machine tools have to be custom built. Seldom do machine tool builders have enough orders for any one type or model to build more machines in one lot than can be seen here. This shows the final assembly and testing of general-purpose grinders.



American women at the controls of modern machine tools are proving they can do a man's job on repetitive operations. They are successfully filling the ranks of our fast-expanding production army. Many factors are making it possible to man thousands of machine tools with women. Not the least important of these is the much-improved design of the machines themselves. Dangerous overhead belt drives are gone. So, too, are inconveniently located controls and open gearing and exposed moving parts which catch clothing and tools. Gone, too, is the need for great physical strength in feeding machines and the problem of lubricating them while in operation.

New Production

A 1300-ton forming press which can be operated either automatically or manually was completed recently by the Watson-Stillman Company of Roselle, N. J., for a manufacturer of aircraft propellers and propeller hubs. It is unusual among larger metal-forming presses in that it can be adapted to either single-cycle automatic operation or hand control, as required. The unit is entirely self-contained, including its 50-hp motor and radial piston pump delivering 45 gpm. Control is by a single lever, latch-operated by a pressure cylinder.

The press is of the vertical, four-column type. Its 35-in. ram exerts a pressure of 2750 psi with a 22-in. stroke. The opening is 37 in. and there is a clear platen area of 48 by 42 in. Advance and return speeds are 650 in. per min, while the pressing speed is 10.5 in. per min. The entire unit occupies a floor space of 8 by 6 ft, is 19 ft high, and weighs 80,000 lb. It is known as No. 8661.

A 100-TON hydraulic straightening press has been announced by Hannifin Manufacturing Co., Chicago, Ill. It has a ram stroke of 18 in. The reach, or distance from the center line of the ram to the face of the frame, is 15 in., the table measures 21 by 96 in., and the distance from the table to the floor is 40 in. When equipped with a 10-hp motor the speed is 40 in. per min during the power stroke and 68 in. per min during the return stroke. This press is equipped with the Hannifin sensitive pressure control. Initial movement of the control lever causes the ram to move down rapidly at nominal pressure, until it touches the work, when it comes to a stop. Further motion of the control lever causes the ram to exert pressure in proportion to the motion of the lever. Release of the control lever at any point automatically returns the ram to the top position at high speed. Between operations the ram remains in the top position and the oil pump idles.

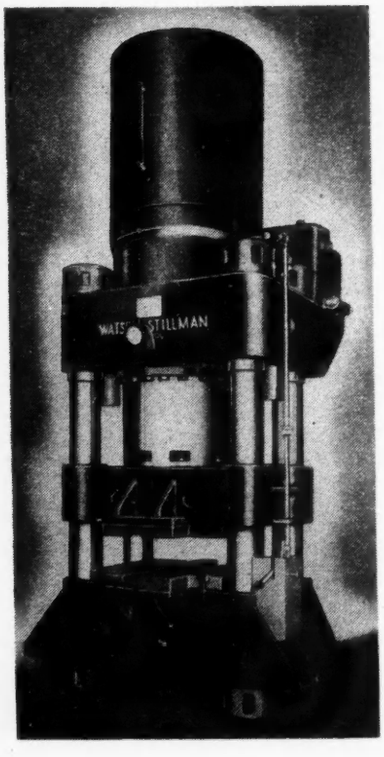
A SMALL automatic milling machine, known as the O-8, manufactured by The Cincinnati Milling Machine Co., can be equipped with a unique hydraulically actuated mechanism which automatically controls the vertical movement of the spindle carrier, synchronized with the table traverse motion. With this mechanism, the machine is capable of handling a greater variety of milling cuts. For example, the device is useful in operations where a projection on the part or fixture prohibits the work from being advanced directly into the cutter (the ordinary milling operation) or where the cutter must be raised and then lowered to pump an obstruction and continue with the milling cut.

The mechanism consists of a hydraulic cylinder and valves mounted in a bracket on top of the machine column, providing a 2½-in. vertical movement of the spindle carrier. Approach of the cutter down to the work may be at a rapid rate of 80 in. per min, an infinitely variable feed rate of 1 to 10 in. per min, or varying combinations of both. Retraction of the cutter from the work is always at the rate of 80 in. per min. Incidentally, the 2½-in. power movement may be utilized over any portion of the 7-in. total vertical range of spindle carrier movement. Machines having this feature are equipped with automatic hydraulic clamping of the spindle carrier in the cutting position.

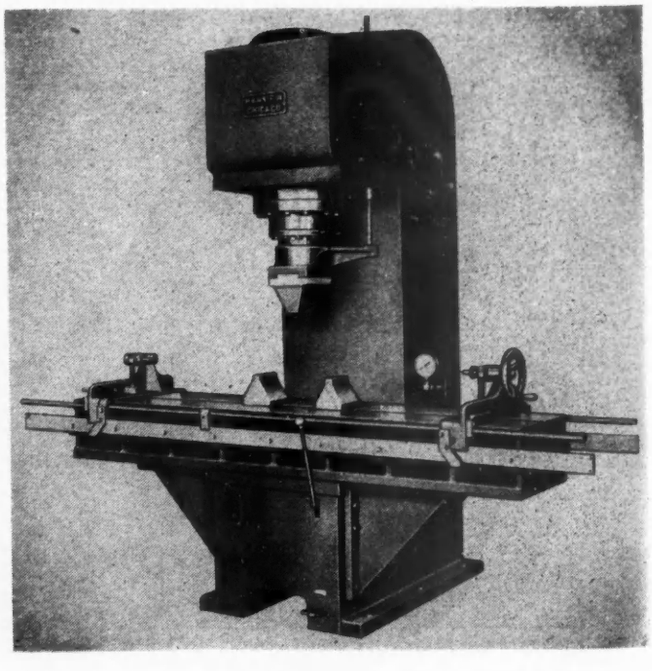
Rapid traverse and feed motions of the table are started, stopped, and synchronized with the vertical motion of the spindle carrier by means of cycle selectors, one of which is shown in the illustration. These cycle selectors, consisting of a simple camshaft assembly, are available for a wide variety of cutting cycles.

THE Sundstrand Machine Tool Co., Rockford, Ill., has put in production a new double-end milling and centering machine suitable for milling to length and centering (in one handling) both ends of shafts ranging from 1⅛ to 6 in. in diameter and from 14 to 72 in. in length.

The base is a one-piece iron unit having horizontal ways. Crosswise to the bed ways are mounted two sub-bases which, in turn, have ways on which cross feeding heads are attached. The left hand sub-base is fixed, but



(Left)
Watson-Stillman 1300-ton forming press built for a propeller manufacturer.



(Right)
Hannifin hydraulic straightening press equipped with the Hannifin sensitive pressure control.

Equipment



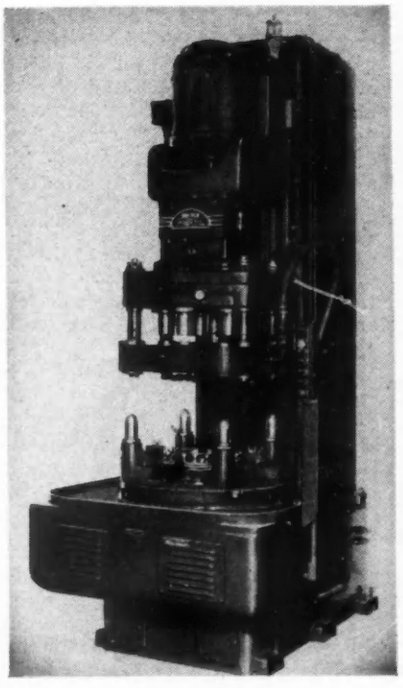
the right-hand base is adjustable for handling various lengths of stock. Mounted to the bed ways between the two heads are two screw-operated self-centering vises for holding the work. These vises also are adjustable for handling various lengths of stock. The drive to the heads is by a main drive shaft driven by a fluid motor. Each milling head is independently motor-driven and carries a cam-operated automatic-centering spindle.

In a cycle of operation the operator loads a shaft into the work-holding vises. He then presses the cycle-control button, which starts cross feed of the heads towards the front of the machine, to mill the both ends of the part to length. At the completion of the cross feed for milling, the heads return rapidly toward the rear of the machine. The centering spindles automatically travel longitudinally in a cycle of rapid approach, feed, rapid return, and stop. This completes the cycle, and the operator unloads and reloads the work-holding vises. The cycle is completely automatic, so that one operator can run several machines. The parts are handled only once, thus the milling and the centering is in a definite relation and can be very accurately controlled.

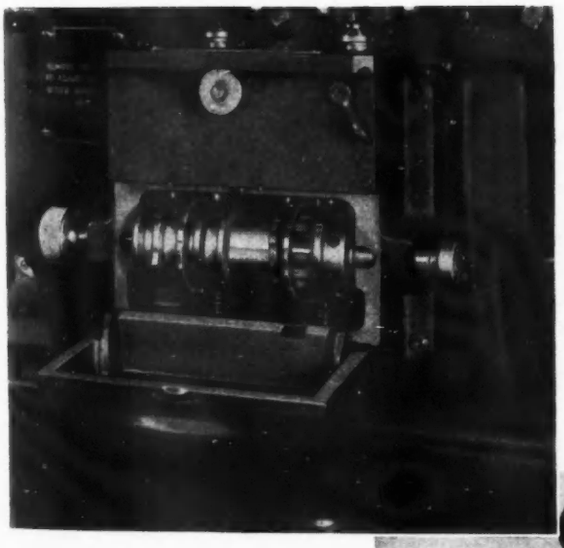
SNYDER TOOL & ENGINEERING CO., Detroit, while mainly engaged in designing and building special machines, also builds the 10 V 18 standard drilling machine shown in the illustration. It can drive tools at up to 15 hp at 1800 rpm. The maximum stroke is 18 in. and the opening between the base and the speed-change gear (on which latter a multiple head is shown mounted in the illustration) is 36 in. minimum and 56 in. maximum. The slide is fed downward under hydraulic pressure which may attain a maximum value of 12,000 lb.

The oil for the hydraulic feed is contained in the reservoir on top of the column, while inside the column are housed the pump, the motor and the

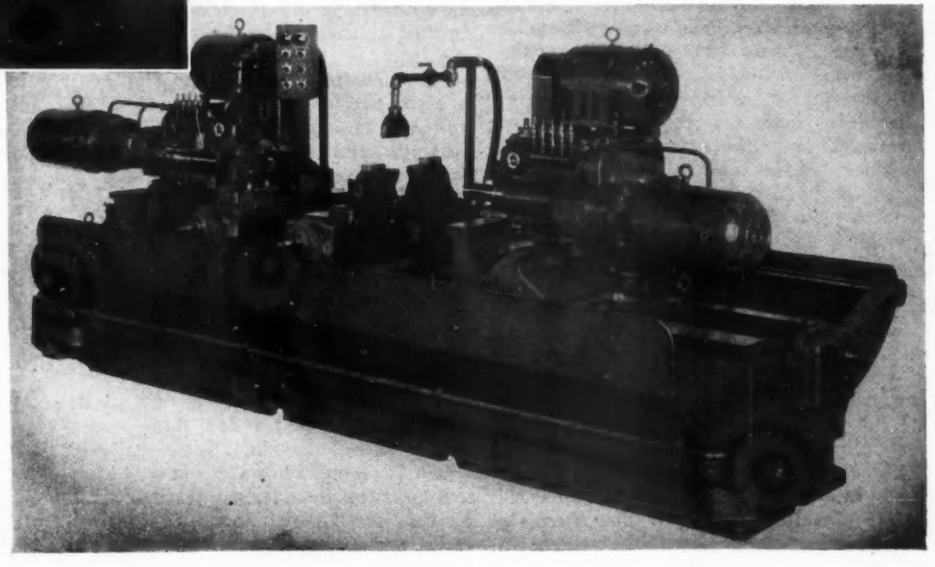
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Snyder 10 V 18 standard drilling machine.

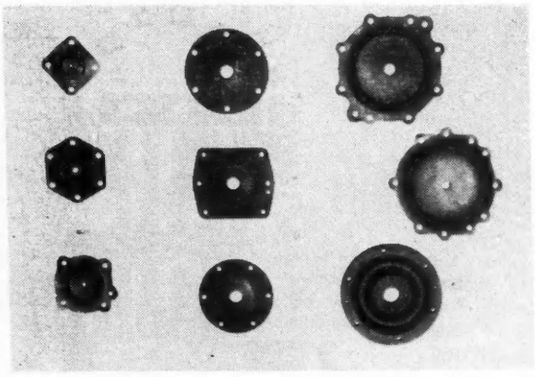


(Above)
Cincinnati milling machine attachment for automatically controlling the vertical movement of the spindle carrier.



(Right)
Sunstrand double-end milling machine.

NEW



Typical small molded parts made of Du Pont "Fairprene".

Fairprene Gasket Material

In the design of an improved airplane carburetor, the problem arose of finding a material from which a permanently flexible gasoline-resistant diaphragm could be molded. It had to be accurate in dimensions and of a thickness of only 0.001 in. The material finally selected was "Fairprene," a cotton cloth treated with synthetic elastic compositions, and manufactured by the Fabrikoid Division, E. I. du Pont de Nemours Co., Fairfield, Conn. Carburetor diaphragms, oil seals, valve seats, shock mountings, grommets, couplings, valve cups, and gaskets are some of the aircraft parts which can be made from "Fairprene."

The new material is claimed to meet the need for a pliable material which could be supplied in the exact degree of hardness, flexibility, or elasticity, along with great resistance to oils, heat, salt air, salt water, weathering, corrosion, and aging.

Impact-Resistant Phenolic Molding Plastic

Bakelite Corp., a unit of the Union Carbide and Carbon Corp., New York, N. Y., has announced the development of a new impact-resistant phenolic molding plastic, designated as Bakelite Phenolic Resin XM-15000. This product was developed to meet the needs of industry for a high impact-resisting molding material that can be preformed on automatic tabletting machines. It is said to be the highest-impact phenolic material that can be performed in this manner. When molded, it has approximately twice the shock resistance of general-purpose phenolics. Its water resistance is also good when compared to other shock-resistant phenolic plastics.

Jessop RT, a Water-Hardening Tool Steel

For applications where extreme toughness is required, the Jessop Steel Co., Washington, Pa., is now furnishing a water-hardening tool steel known as Jessop RT. It is said to have unusual toughness and strength, and to give very good performance, especially in applications to what are known as "battering tools." In spite of its great hardness and strength, the RT steel has sufficient ductility so it will stretch more than 4 per cent before it will break. It is claimed that a test on a properly treated RT test specimen will show a breaking strength of 323,000 psi and an elongation of 4.5 per cent in 2 in. When large and medium sizes are hardened, Jessop RT acquires a hard case and a tough core. A 1½-in. piece will show a fine-grained case from 3/16 to ¼ in. deep, of about C-61/63 Rockwell hardness. The smaller sizes (under ¾ in.) will harden throughout.

Crobalt Inserted Tools

Crobalt, Inc., Ann Arbor, Mich., announces a new line of Crobalt inserted tools, in a wide variety of standard sizes for turning, slotting, and parting. These tools use Crobalt alloy at the cutting edges only. Crobalt is a nonferrous cutting alloy, containing cobalt, chromium, and tungsten. Its properties are said to place it about mid-way between high-speed steel and tungsten carbide; it is faster-cutting than the former and less liable to breakage than the latter.

The new tools require no change in present equipment. One important advantage claimed for Crobalt is that cutting qualities remain unimpaired until the metal is heated above 2000 F. It is also claimed to possess high abrasion resistance, a low coefficient of friction, and adaptability to surface speeds of 120 to 250 fpm.

Flame-Resistant Insulating Varnish

The Sterling Varnish Co., Haysville, Pa., has developed a new flame-resistant insulating varnish, known as R-878, which it recommends for Class B high-temperature insulation. It is claimed for this new varnish that it is mechanically strong and dries all the way through when applied to electrical apparatus; that after drying it will not support combustion, when the flame is removed; and that it will not melt or resoften under operating temperatures. In addition to having good heat-resisting qualities, it is said to have all the characteristics of a high-grade insulating varnish.

Carboloy Shear-Type Tools

Chiefly for interrupted cuts on large steel parts, Carboloy Co., Inc., Detroit, Mich., has established standardized designs of "shear-type" tools. These are characterized by a large negative back rake which results in a shaving form of cut when used for turning or facing. Thus, when the tool is used for



interrupted cuts, the impact load on the tool does not come at the end of the tip but farther back. Also, the entry of the cutting edge of the tool into the work after each interruption is gradual, starting at the point of contact back from the tip and working forward to the tip of the tool. The line includes four basic sizes of tools in both left- and right-hand varieties, or a total of eight types. Shank sizes include 1 by 1, 1¼ by 1¼, 1½ by 1½, and 1½ by 2 in.

New Lincoln Arc-Welding Electrode

A new arc-welding electrode for use with its "Fleet-Fillet" technique, has been announced by the Lincoln Electric Co., Cleveland, Ohio. "Fleetweld 11" is claimed to be not only fast-flowing, but to give deeper penetration of metal into

MATERIALS

the root of the joint. It is of the shielded-arc type, and is heavily coated to exclude oxides and nitrides from the weld.

High currents are used, the electrode is advanced at a higher speed, and the weld metal penetrates into the corners where the two pieces of metal are joined. The electrode is held at an angle of 45 to 60 deg with the horizontal plate, and at 90 deg with the electrode path along the joint. The arc produced is so short that the electrode coating practically touches the metal.

As regards the saving in electrode metal, the company states that in a typical case the new technique required 0.26 lb of electrode per foot, as compared with 0.37 lb by the usual procedure.

Fleetweld 11 is made in 18-in. lengths and two diameters, 3/16 in. and ¼ in. It comes packed in 50-lb cans.

Fabrikoid Luminous Fabric

A coated fabric developed by du Pont glows with visible light in complete darkness. It may be cut into letters or strips to mark doorways, staircases, hand-rails, fire extinguishers, arm bands, instrument dials, control panels and the like. The fabric is said to be much cheaper than luminous paint; it can be applied to any type of surface with casein glue, wallpaper paste or thumb tacks, and when so applied can be easily removed. Exposure to electric light or sunlight for only thirty seconds is sufficient to give the coating the power to glow from four to six hours. The bluish light emitted by this new material under total blackout conditions may be renewed indefinitely by re-exposing it to light.

A protective topcoat also has been evolved, to provide additional durability for outdoor use. Luminescent-coated fabric is available to industrial fabricators in a sheeting fabric base in 60-yd rolls of 40-in. width. It is the product of the "Fabrikoid" Division of E. I. du Pont de Nemours & Co., Wilmington, Del.

Self-Lubricating Bearings

The United States Graphite Co., Saginaw, Mich., is now supplying self-lubricating bearings to many of the larger airplane manufacturers. Before the war it is said to have been one of the principal suppliers of the automobile industry, having produced in excess of 20,000,000 bearings in 1941. The trade name Gramix was applied for a great many years to the special bronzes employed in self-lubricating bearings. More recently, the range of compositions has been extended to include iron mixtures which, in some instances, take the place of critical materials.

Velvetouch Metallic Friction Material

One of the leading organizations in the field of powder metallurgy is The S. K. Wellman Co., Cleveland, Ohio, whose specialty is the production of friction materials from sintered powdered metals bonded to steel. "Velvetouch" bi-metallic friction materials take the place of conventional friction linings on heavy-duty clutches and brakes for motor trucks, tractors, marine reverse gears, automatic transmissions, industrial machinery, etc.

Velvetouch is a bi-metallic friction material consisting of various selected combinations of powdered metals such as copper, tin, lead, etc., compressed, sintered, and bonded to a solid backing for support. Typical facing arrangements are illustrated here. This type of lining is used also on cone brake hubs for special power units; on internal- and external-brake bands and clutch bands. One of its latest applications is to heavy-duty airplane brakes.

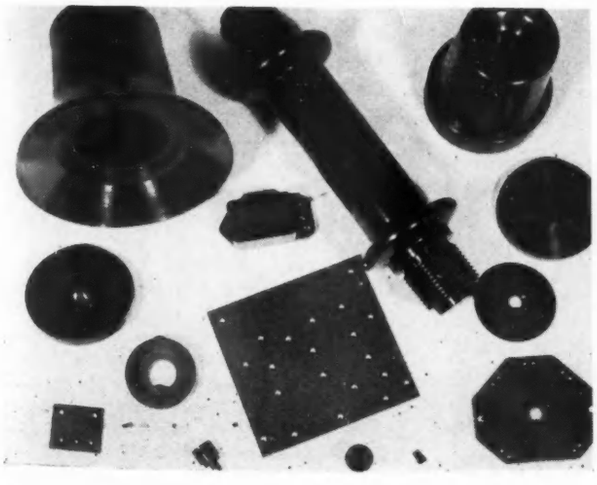
New UHF Insulation

Dilectene is a red-brown synthetic resin which contains no cellulose filling materials such as paper, fabric, or wood flour. Since the presence of fillers is one of the primary causes of water absorption by plastics, their absence means that this material is highly resistant to moisture, and consequently very stable electrically.

This new ultra-high-frequency insulation, manufactured by the Continental-Diamond Fibre Co., 20 Chapel St., Newark, Del., is available in two grades: Dilectene 100 and Dilectene 160, a plasticized grade. The choice between the two materials for a given application depends upon requirements. Where resistance to moisture and a tendency to resist cold flow are important, Dilectene 100 is recommended; where ease of working is the prime factor, Dilectene 160 should be used.

Dilectene is available in sheets and rods, but not in tubes. Sheets, which are approximately 15 by 33 in., are made in thicknesses from 1/16 in. to 1 in. Rods up to 1 in. in diameter are cut from sheet stock; rods from 1 to 2 in. in diameter are molded. Rods of Dilectene 100 are available in sizes up to 1 in. in diameter; rods of Dilectene 160, up to 2 in.

The material can be machined readily, but it is not recommended for punchings. Sheet stock can be formed to simple shapes in molds.



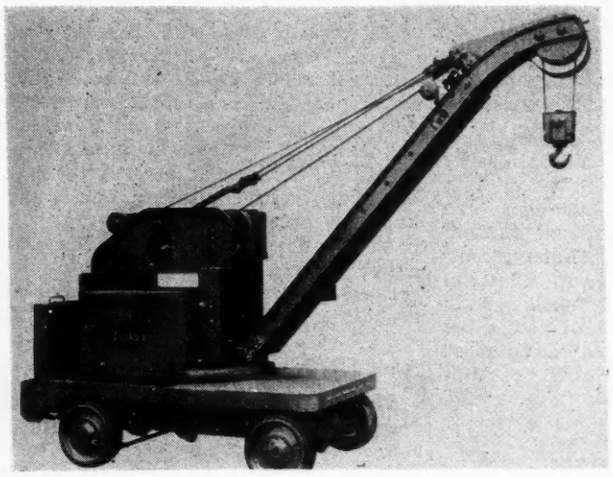
Parts formed from Dilectene, a new ultra-high-frequency insulation manufactured by the Continental-Diamond Fibre Co.

Ethyl Cellulose Adaptable to Many Uses

Ethyl cellulose is a new chemical product introduced by the Cellulose Products Department of the Hercules Powder Co., Wilmington, Del., for which many industrial uses have been found already. It is a cellulose ether made by the reaction of ethyl chloride on alkali cellulose, and is furnished as a white, granular product. The physical properties vary somewhat with the degree of substitution, but the characteristics of the material may be listed in general terms as follows: Excellent solubility in a wide range of cheap

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Materials Handling Equipment



Baker type CXF crane truck.

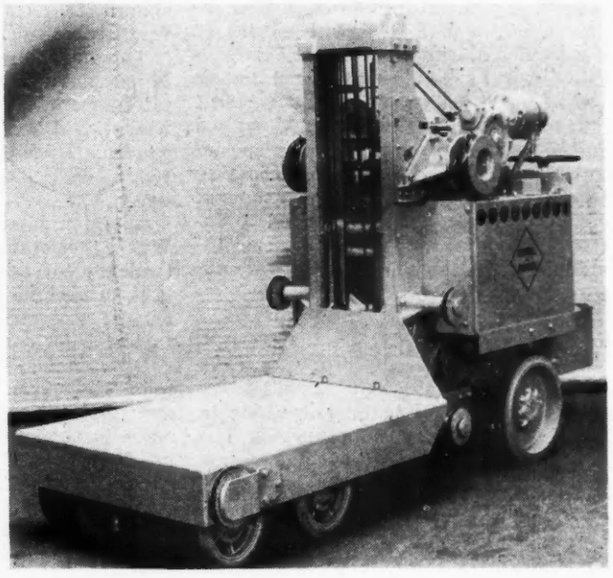


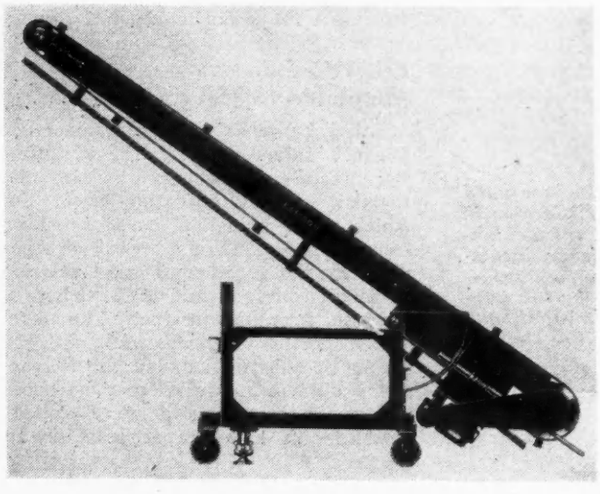
THE Baker Industrial Truck Division of the Baker-Raulang Co., Cleveland, Ohio, announces a new heavy-duty 10,000-lb. crane truck known as the Type CXF. In this truck unnecessary dead weight is eliminated by so positioning the hoist units that they are available as counterweight. The bridging over the top of the battery compartment is made narrow, so that the operator can look along either side, which makes for safety in operation.

The mast on which the superstructure slews is a tall member and has two widely-separated bearing points, which results in low bearing loads. This mast height permits a high position for the topping cable idler sheave, which gives a favorable angle of pull when raising the boom from a low position. All controls are conveniently located on the dash and do not swing with the superstructure.

This mobile crane is adapted for erecting work, for combined lifting and transporting operations, for placing work in machines, and for many other applications. It supplements the overhead traveling crane, and two or more units can work in the same bay, passing each other.

Ellwell-Parker industrial track designed for the handling of heavy dies.





Improved Lamson Model CM utility conveyor.

WITH unit loads in the modern aircraft plant increasing in size and weight, the capacity of power industrial trucks to transport them has also been rapidly expanded. Electric trucks of the standard type built by The Elwell-Parker Electric Co., Cleveland, Ohio, have been provided with special power attachments to transport heavy dies to and from storage, to place them in the forming press, and to remove them after the stamping job is finished.

The company manufactures trucks of 6000- to 20,000-lb. capacity, especially

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The AIRCRAFT INDUSTRY is Doing Its JOB



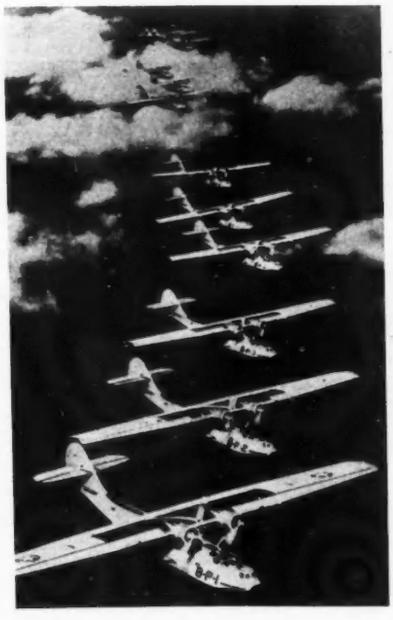
By
Donald W. Douglas
President, Aircraft War Production Council, Inc.

WHEN President Roosevelt, last January, asked the airplane manufacturers of America to build 60,000 warplanes in 1942, it is quite likely that Schickelgruber, Benito and Hirohito sent messages to each other, broadly hinting that Mr. Roosevelt was going to be disappointed.

How could an industry whose greatest plane production up to then had been 1800 planes in a month ever meet such a fantastic demand? Even in America there were many loyal citizens who wondered if it could be done. It looked like an insurmountable task to practically everyone but President Roosevelt and the heads and engineering and production executives of the aircraft companies. These aircraft manufacturers accepted the production challenge, rolled up their sleeves and went to work.

They had been called upon to produce fighter planes, medium bombers, heavy bombers, dive bombers, training planes, torpedo planes and cargo planes to the number of 60,000 in a year. But in addition to the 60,000 planes for this year, they were also asked to produce 125,000 in 1943. Impossible, do you say?

No! Today the American aircraft industry proudly can say the 60,000 production rate will be attained, and—given the material and manpower—we are confident that the ordered 125,000 will roll off the production lines in 1943.



Today more than 4000 warplanes are being produced monthly by the old line aircraft companies, and it will be from these companies that the 1942 quota of 60,000 planes will come. While producing these planes at an unprecedented rate, the aircraft companies have also been contributing their plans, processes and technical knowledge to the training of the automobile and other industries for the construction of planes. When these other industries get under way the old line aircraft manufacturers are certain that the combined production will readily meet the demand for 125,000 planes in 1943.

To meet the demands for 60,000 warplanes this year, the aircraft companies faced a gigantic task, for it meant vast expansion of plants, construction of tools and equipment, training of hundreds of thousands of workers and placed on the shoulders of already overloaded aeronautical engineers a job never before dreamed of. The plants were enlarged, new ones were built, tools were acquired and men were trained. The aircraft industry today is doing its job.

Roaring evidence of the work



Many wing sections for the giant B-24D bomber getting readied for the final assembly line. The four-motored B-24D's are being turned out in ever increasing numbers by Consolidated on its moving assembly line, the first of its kind for big bombers.



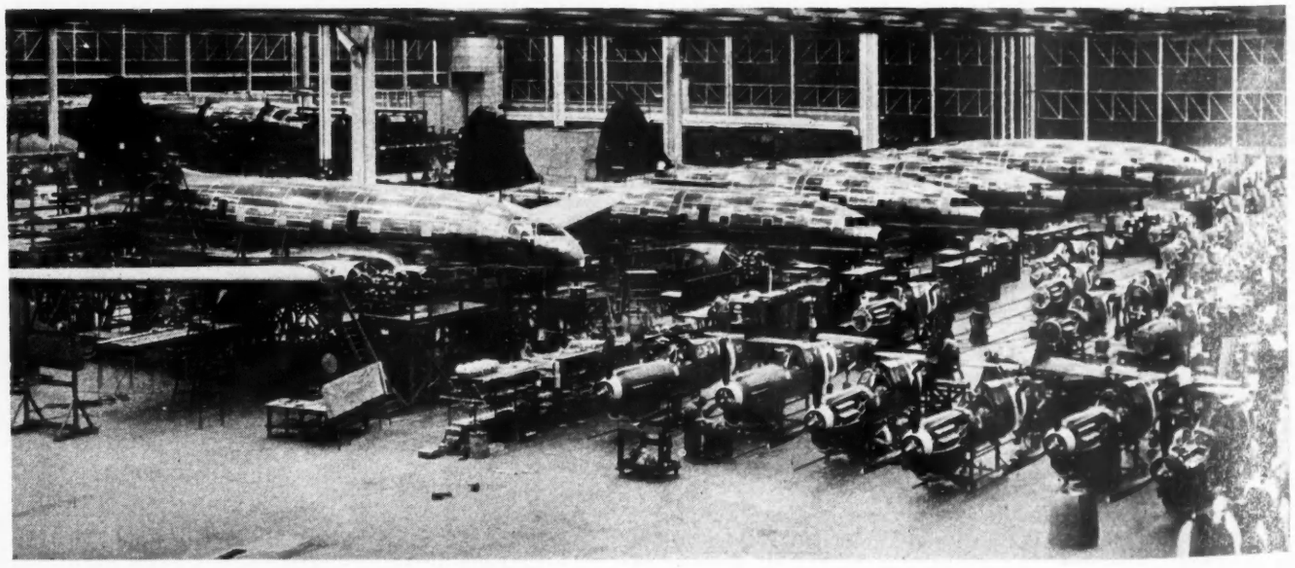
of the airplane companies is heard today in the skies and on the ground in every section of the world. These planes are blasting the enemy over Germany, occupied France, Holland and Belgium, the Mediterranean. North Africa, China, New Guinea, the Solomon Islands, the Aleutians, and, as everybody knows, have even blasted Tokyo. Members of the American aircraft industry are united in the resolve that the numbers of these planes be doubled again and again until the enemy is blasted out of the skies and his armies are crushed beyond repair.

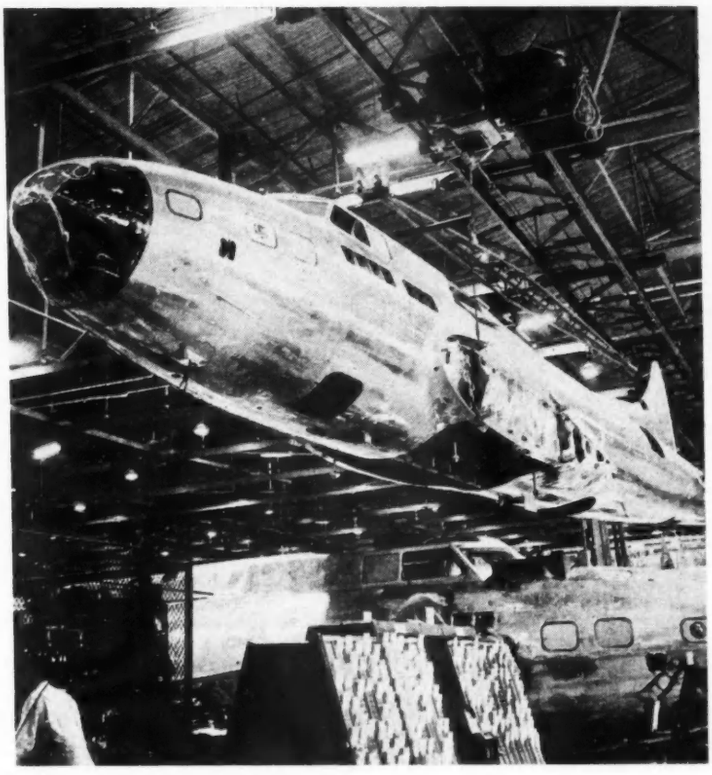
While emphasis is being placed on the production of battle planes, transport and cargo carrying planes are also rolling off the assembly lines. Great cargo planes with boxcar capacity are already carrying men and supplies to the battle-fronts of the world, and the number is steadily increasing.

At a time when on all sides is heard the cry that production in many war industries is lagging, it may seem strange that the aircraft industry should be able to forge ahead and set new production records consistently. To those within the industry it is not strange, for the aircraft manufacturers decided at the outset that cooperation will bring results no matter what the task. East, West, North and South they have become saturated with the idea of cooperation, and the results speak for themselves.

On the Pacific Coast where eight of America's principal airplane companies are located in two counties of Southern California, and another in the Northwest, the company heads decided that what was needed was a

Proving the versatility of assembling of the Airplane Division may be seen here as large Curtiss-Commando Cargo Transports, Curtiss Kittyhawks, and Warhawks proceed down the final assembly stations simultaneously.





At the Boeing plant Flying Fortress fuselages are moved by a monorail crane system over completed fuselages on their way to the final assembly line, thus enabling floor space to be utilized to the best advantage.

central agency for coordination of effort and pooling of facilities for increased aircraft production. So the Aircraft War Production Council, Inc., was formed. The Council comprises Consolidated, Douglas, Lockheed, North American, Northrop, Ryan, Vega and Vultee airplane companies.

When the Council was formed it was in the belief that eight manufacturing companies could do more as a coordinated team than as individuals. Geographic location of the member companies in a compact group made possible an unusually successful application of the belief, strikingly illustrated by the following graphic example:

At 5 o'clock one evening a few weeks ago the factory manager of one plant telephoned the factory manager of another.

"We're facing a terrific handicap on our bomber production line," explained the first manager. "We're short of landing gear drag struts, and it looks as though we will be slowed down on the night shift."

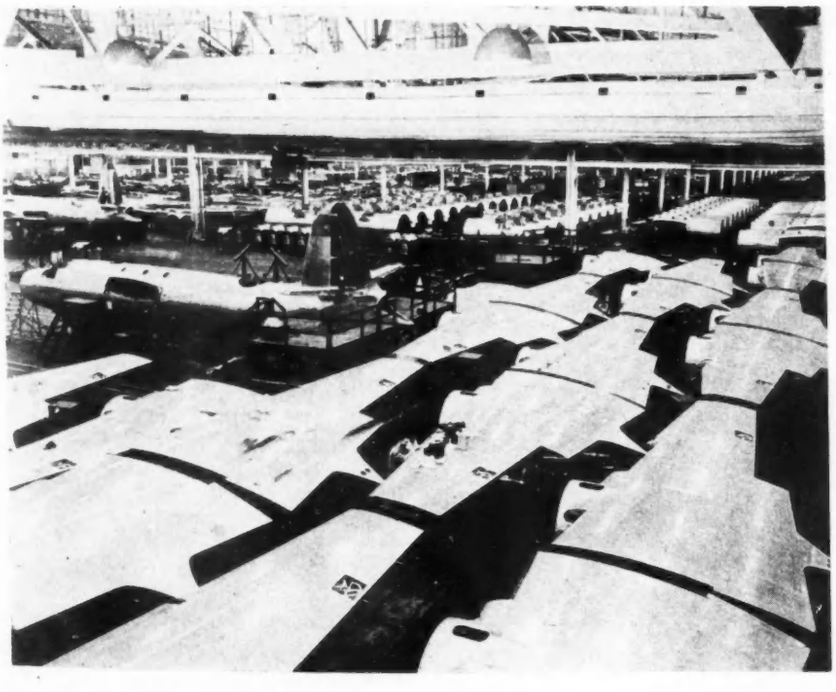
"Don't worry about that," replied the other factory manager. "I can fix you up right away."

At 8 o'clock that evening the one plant had sent over on loan to the bomber plant sufficient landing gear drag struts to keep production rolling.

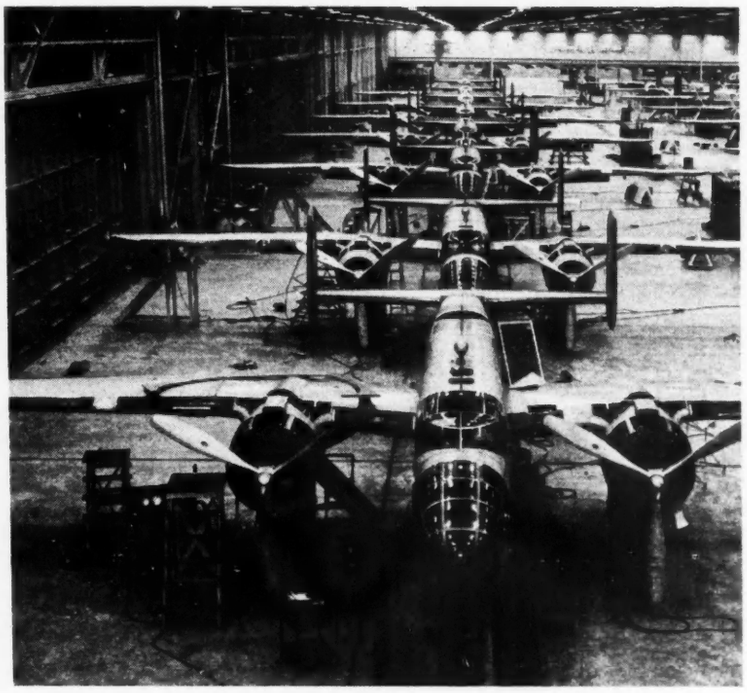
That's one reason why the aircraft industry is meeting the schedule of President Roosevelt's planes this year. That sort of cooperation is one of the accomplishments brought about directly by the Aircraft War Production Council. This interchange of information and manufacturing resources is not confined solely to the membership of the Council. Boeing, the other large Pacific Coast airplane manufacturer, maintains close liaison with the Council. The Council's regional work is projected nationally through cooperation with individual war plants through the armed services and Governmental agencies.

The minutes of the Council carry this instruction: "It is the instruction of the Board of Directors that members of the Advisory Committees shall be free to interchange all information which will help the war production of the company receiving the information, without regard to protection of manufacturing processes which in normal peace times might be regarded as secret. This information shall be available not only to members of the Council, but to manufacturers and Government agencies outside of the Council, in exactly the same manner as the information is interchanged among Council members."

The spirit of the Council mem-



The assembly floor for the B-26 bombers covers a wide expanse at the Martin plant.



B-25 medium bombers, similar to the type used to bomb Japan last April, are in quantity production at North American Aviation's Kansas plant. B-25's have been in action in China, India, New Guinea, the Philippine Islands, and in Egypt.



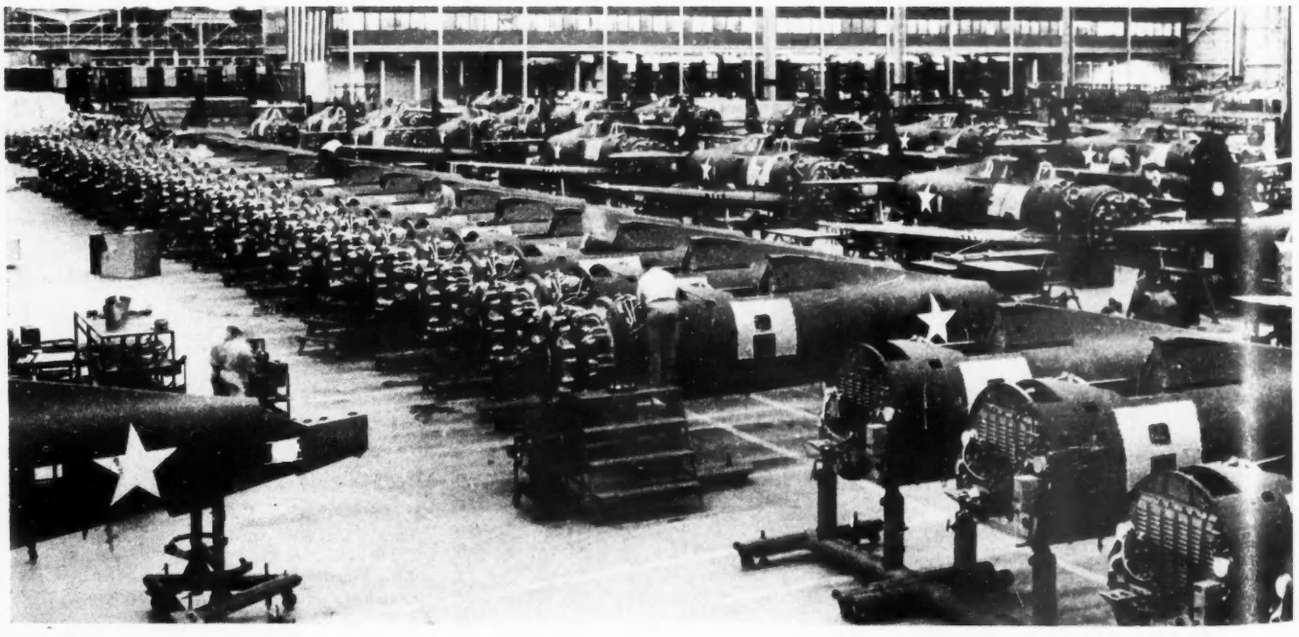
bers has spread throughout the industry. If an Eastern aircraft company, not a member of the Council, faces a problem which its management thinks a Western company can help solve, a call for help is sent out. Information is forwarded and aircraft production is kept at top speed; planes and more planes roll off the production lines in all sections of the country at a faster and still faster rate—planes which President Roosevelt asked for to speed the United Nations to victory.

When it was decided that members of the automotive industry would convert some of their plants to construction of warplanes, the aircraft industry turned to and gave unsparingly of its skill, engineering plans and other facilities to help the auto makers to prepare to make their share of next year's 125,000 warplanes.

For example, when the Ford Motor Co. first entered the warplane production field, Consolidated Aircraft Corporation gave Ford at all times the closest of cooperation in connection with his preparation to build B-24 Liberators at his Willow Run plant. Ford engineers and production representatives, frequently numbering well over 200, were given free access to all parts of the Consolidated plants having to do with the building of the B-24 Liberator and other planes.

All designs, blue prints, engineering and production data were turned over to Ford, and his representatives had the counsel of all of Consolidated's experienced

From this portion of the Republic final assembly line roll the Republic P-47 Thunderbolts.

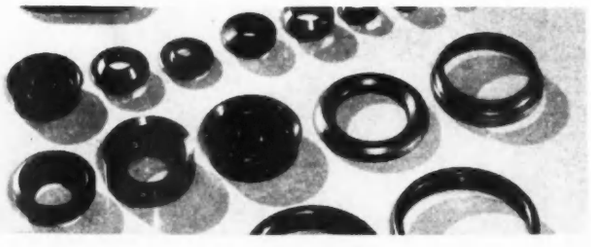




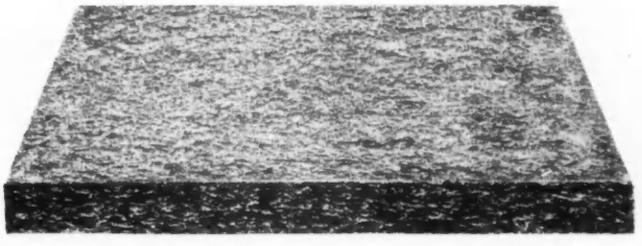
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Huge Cargo planes on the production line at Douglas plant.

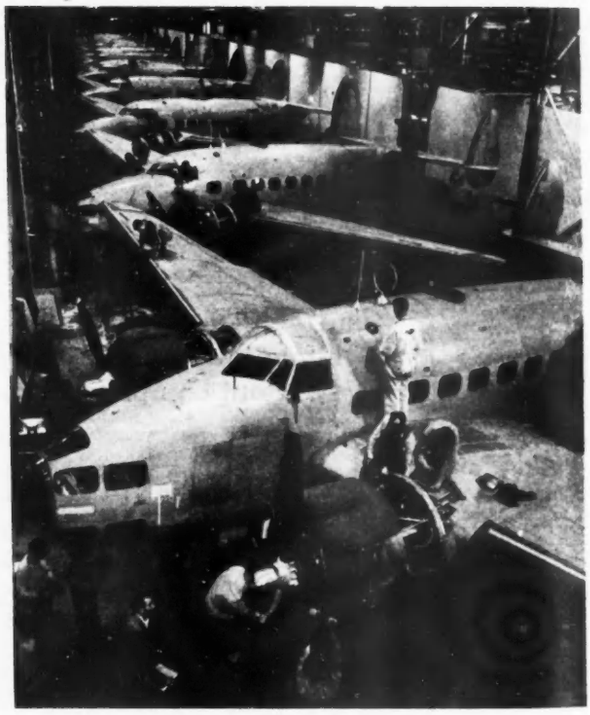
management personnel on all occasions. At the request of the Ford Company, Consolidated sent many of its engineers and production executives to Willow Run to render all possible assistance in acquainting them with the production of the B-24 Liberator. This data quite naturally contained much that in ordinary times would have been released to no other company. But the aircraft manufacturers feel that there is a vital job to be done; a job of far more importance than is individual gain, so they have no more secrets for the duration.

During this period Ford production experts spent considerable time in the Douglas plants, and were given valuable data and advice. Information obtained from Consolidated was amplified by Douglas engineers in an effort to speed sub-assembly plans for proposed branch plants to be supplied by Ford.

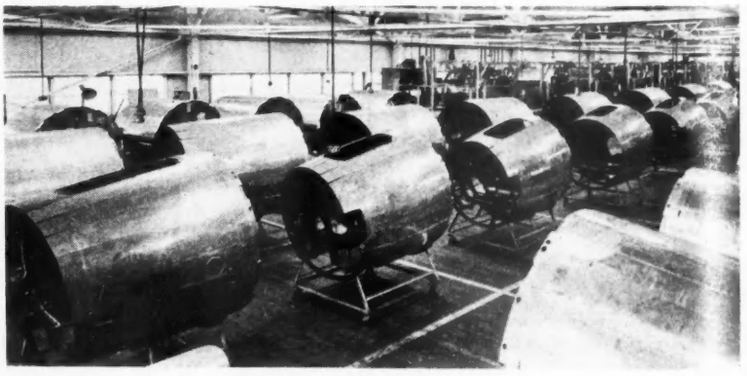
Another example of old line aircraft company cooperation with the automotive industry is that of North American Aviation and a number of General Motors'

(*Turn to page* 124, *please*)



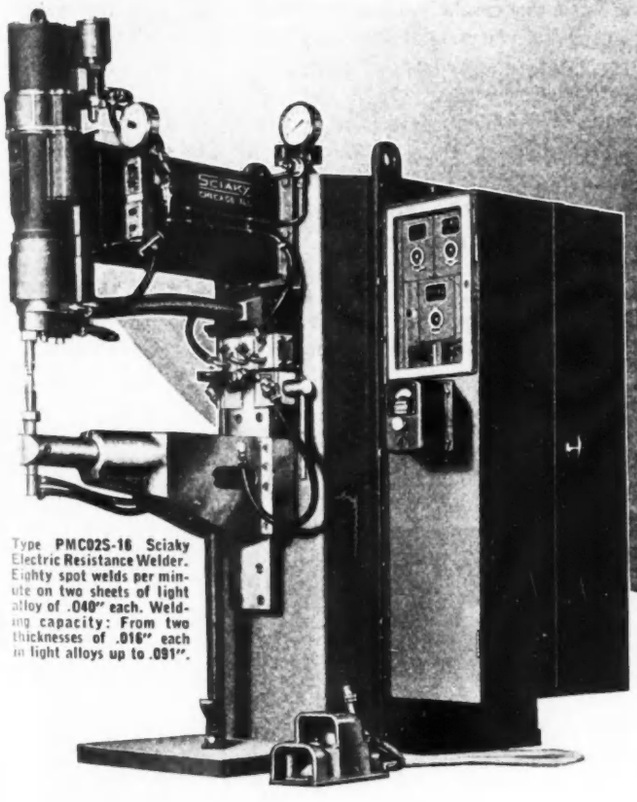


Here is a line of the famous Hudson bombers at Lockheed.



Nacelles for Flying Fortresses are a part of the production at Northrop Aircraft, Inc. These nacelles are the engine mounts seen projecting from the wing. Parts of Flying Fortresses as well as the complete planes are made by many members of the Aircraft War Production Council, Inc., in speeding the big bomber program.

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Can Take It!



By Otto W. Timm
President, Timm Aircraft Corp.

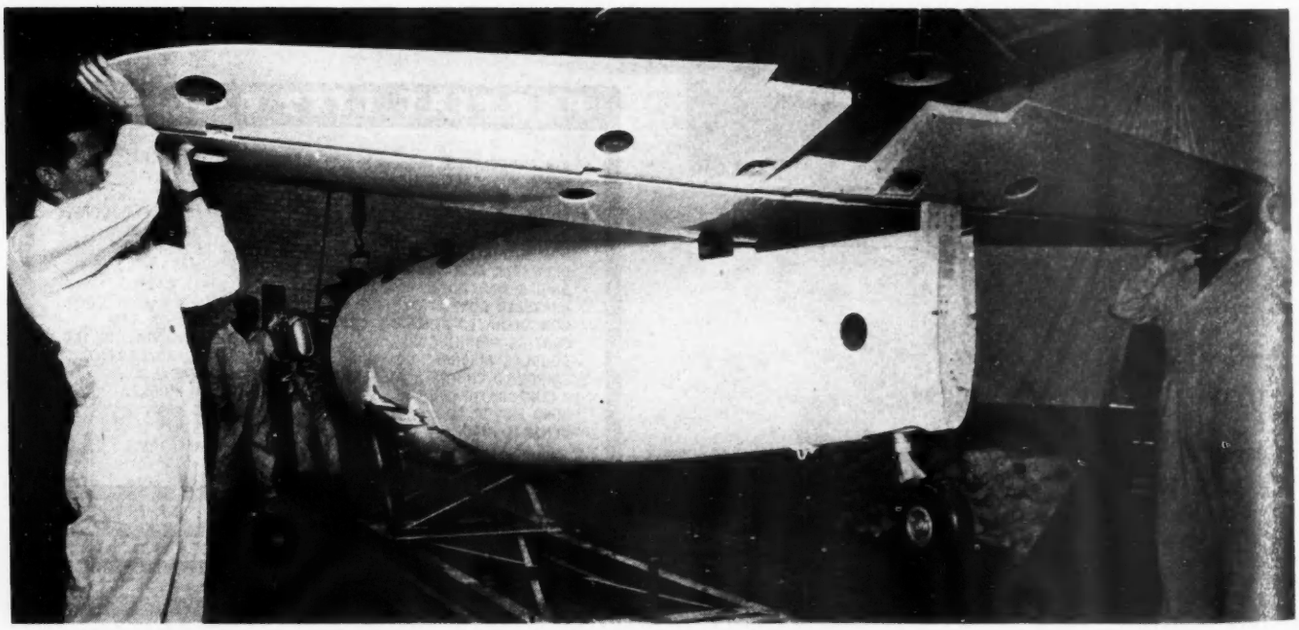
THE ancients knew its secret. During World War I it was an important material. American engineers lost sight of it in the metallic age that followed that war. Europe developed it and is using it skillfully, and now the faith of American technicians, which had remained undaunted, is coming into its own.

Much fanfare has surrounded plywood in recent months. When President Roosevelt announced that 50,000 and then 125,000 planes a year were to be produced (the exact heights to which this figure has been pushed now is a military secret) it was at once obvious that the amount of metal needed for this program, if planes were to be built as they had been, far exceeded the most optimistic aluminum production estimates. Something had to be done, but quickly. Substitute materials had to be made available, and they were, for plywood is not only "just as good as" metal for plane construction, it is, today, in many ways, a great deal better.

At present, in addition to planes built entirely of plywood, thousands of components are made of this basic material. Pilot seats, trim, tabs, bomb-bay doors, control surfaces, radio masts, wing tips, floors and bulkheads of plywood now are appearing in metal planes.

North American Aircraft alone saves more than 250 pounds of aluminum per ship by using plywood for the fuselages of the AT-6 combat trainer. Every pound

Attaching tail-surfaces which have been formed and cured.





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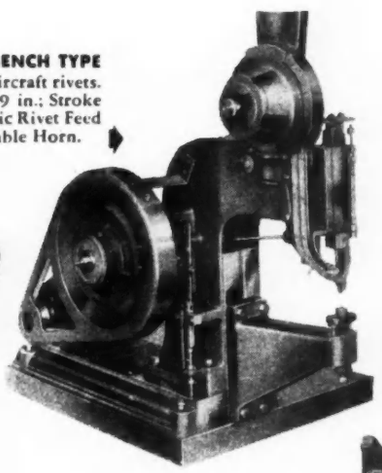


MODEL 121 FLOOR TYPE
Sets 3/16 in. aircraft rivets. Throat depth 9 in., Stroke 2-2½ in.; Automatic Rivet Feed and Adjustable Horn.

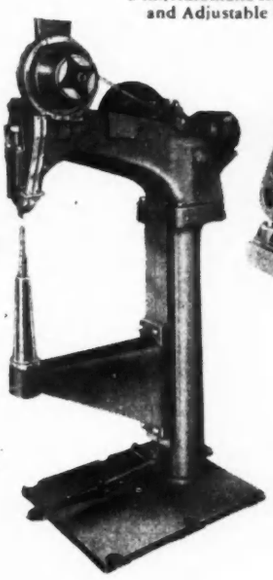
MODEL 90 FLOOR TYPE
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MODEL 71 BENCH TYPE
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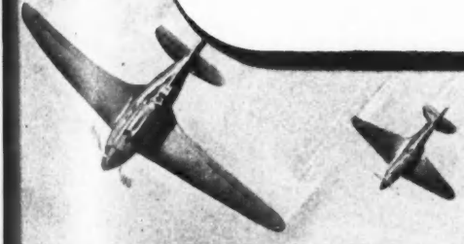




MODEL 140PT POST TYPE
Sets 3/16 in. aircraft rivets. Throat depth 24 in.; Stroke 2-3 in.; Posts 6 to 18 in.; Automatic Rivet Feed and Adjustable Horn.

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of aluminum saved in this way makes it possible for America to build more fighting planes. But the greatest encouragement to plywood-research enthusiasts has been the satisfactory performance and Navy acceptance of the all-plywood training plane.

During the first world war the majority of planes were made of wood, but at that time plywoods were not sufficiently developed to withstand for long periods of time the damaging effects of moisture, oil, fungus, etc. As a result of some tragic failures from 1914 to 1918, engineers steered clear of wood and developed metal construction. Today they are realizing that the few research engineers who refused to lose faith in wood have developed a material that can compete with any and all others.



The recent surge of plywood has left inevitable headaches in its wake. The lack of exact specifications in plywood manufacture, due to the novelty of the material, has caused aircraft engineers accustomed to metal uniformity to tear what little and graying hair they may have left. But once plywood is firmly established as the important material it is, and its value is clearly understood, the now harassed plane engineers will be able to order and receive exactly what they call for.

The tremendous renaissance of plywood stems from the development of the plastic bonding agents that now create the material. Several methods are being used in the production of plywood and molded parts, two of which require considerable pressure and heat. The method which has been extensively developed by our firm involves the use of cold-setting bonding materials. Moderate heat is applied to accelerate the setting of bonding material to facilitate rapid production. However, the quality of the bond is equally good whether heat is applied or not. When a need for repairs arises in the field, the cold-setting bonding agent needs no heat for setting, and all the pressure necessary is obtainable with simple "C" clamps.

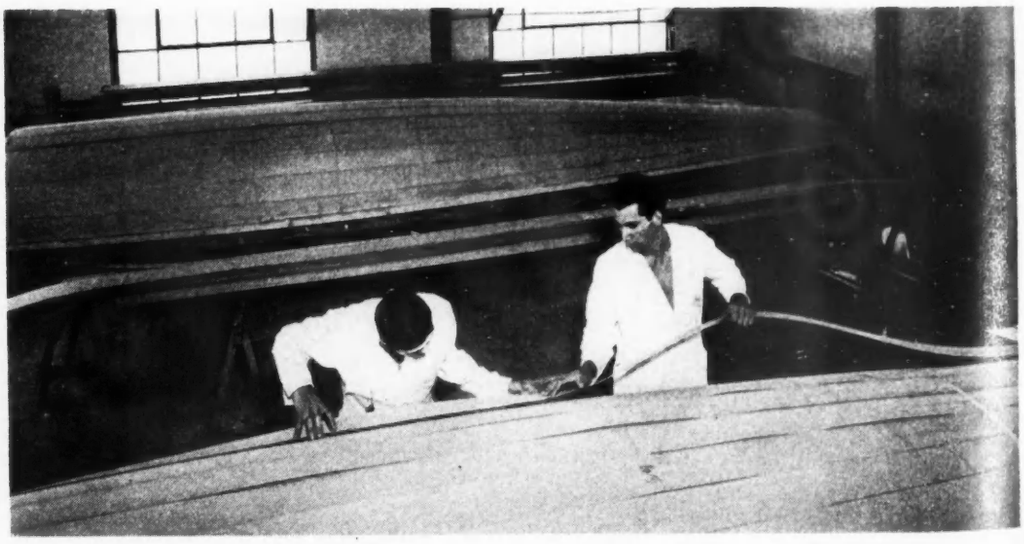
The ease with which all-plywood ships can be repaired is illustrated by an incident that happened on an Eastern airfield. One of our ships was scheduled for an important test flight. Parked between two huge bombers, it was ready for testing that afternoon. A sudden blustery wind caught the ship and hurled it into the propeller of one of the bombers. The collision ripped through its wing and deeply gashed the aileron.

A woodworker was found in a hurry, he scarf-jointed a new piece of plywood into the torn wing, it was set with our plastic bonding agent, and when the patch was painted the wing was as good as ever, and the break hardly discernable. Four hours after the accident that plane flew off for its tests. It is still flying today, just as strong as ever, and it still sports the same patch job.

A United Press dispatch from the Far East last fall also illustrates the speed with which plywood can be repaired. I quote: "In order to save aluminum, the Soviet engineers made the wings (of the type MIG-3 fighter) of plywood. I saw an MIG which was hit in the wing by anti-aircraft shrapnel, but the wood was not splintered and the plane was able to return to base. It was a simple operation to 'unbutton' the damaged wing and 'button' on a new one, whereas it would have taken a long time to repair a metal wing. Apparently the MIG's can dive as fast as all-metal planes, and Soviet airmen claim their 'coefficient of safety' is higher than that of most foreign fighters."

Today's synthetic bonding agents have created an aircraft production material that is equal or superior to metal. Plywood's advantages are many: there is virtually no limit to the amount of wood available for making plastic-bonded plywood. Because of its thickness it is fire-resistant to a far greater extent than magnesium or aluminum alloys. It is corrosion-resistant, which is particularly valuable in naval aircraft and in aircraft for tropical assignments.

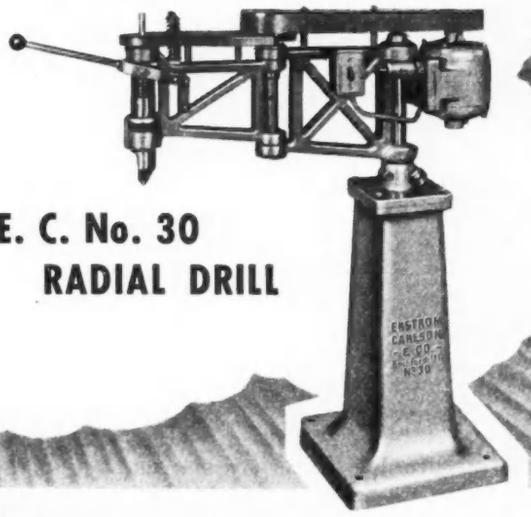
Plastic-bonded plywood does not splinter in a crash. It stands up remarkably under gunfire, bullets and metal fragments, leaving clean holes only the size of the projectile, while in metal construction bullets splay.



First step in fuselage construction. Strips of spruce veneer, cut to shape under steel template, are laid lengthwise over a wooden form.

ESSENTIAL MACHINES FOR AIRCRAFT MANUFACTURERS

Nothing new under the Rising Sun—but here are three bottleneck-breakers to help you and your country rout the Axis. All over America E. C. machines are answering the Axis with production and still more production.



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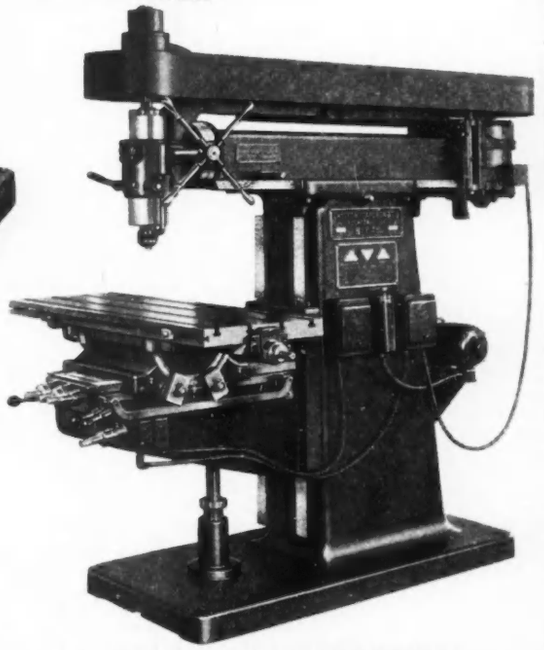


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Finished half of fuselage shell. After coming out of mold where it was cured under heat and pressure for several hours. Notches for cockpits and center-section of wing are cut to template before shell is fitted to diaphragms and stringers which have been assembled on fuselage jig.





leaving jagged tears in their wake. Gunfire also tends to pull metal plates loose at the rivet joints, while plywood plastic joinings are not affected.

The thickness of bonded plywood also makes pulsation negligible and the material does not fatigue due to vibration, like duralumin. The elimination of rivet heads and overlapping edges permits greater speed than in a similar metal formed ship. The resilience of plywood makes wooden planes less vulnerable to the rough usage usual on an airfield in war times; whereas a blow will dent a metal plate, plywood "can take it."

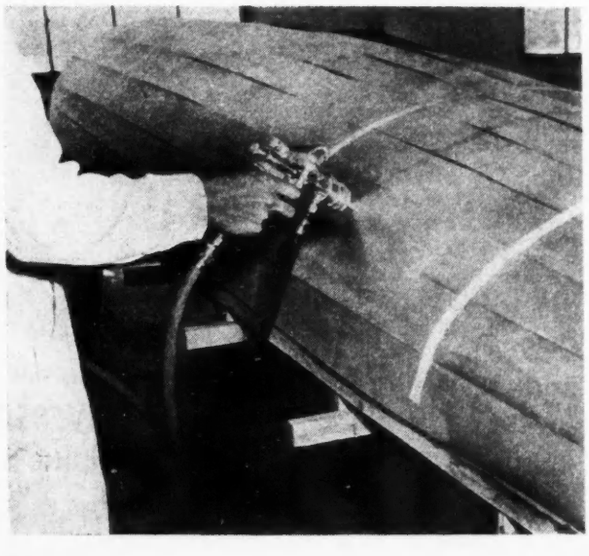
The government has become conscious of wood as a means of speeding aircraft building, and not long ago appropriated a large sum of money for research and development work on wood products and glues for aircraft construction at the Forest Products Laboratory at Madison, Wis. Many important developments have come from this laboratory already. One of the most interesting is a plastic-bonded plywood formed under pressure and compressed to about one-third its normal thickness. The result of both impregnating the wood veneers with plastic bonding agents and compressing to such a great extent is a finished material with a greater strength-to-weight ratio than any metal now being used by the aircraft industry. It will also take a very smooth surface finish.

Most encouraging to the advocates of plywood planes is the fact that these can be produced by hundreds of thousands of workers who have heretofore been engaged in furniture and similar wood assembly work. The men are available for war production, and because of their present skill, they need almost no re-education.

Furniture manufacturers have been hesitant to enter the aircraft-production field because of the bugaboo of technical engineering details and a fear that their workers, used to rule of thumb methods, would not be able to deliver the close tolerances so necessary in the aviation field. Actually, such a changeover would be less of an upheaval than the changeover of many metal-working firms' activities to war production.

The average sash and door mill has the equipment to cut and fabricate plastic-bonded wood components. Furniture craftsmen understand wood-working tools, and in most cases they would be using identical tools in aircraft production. Working to close tolerances means only more patience and care.

The conversion of facilities now devoted to furniture production would create 2100 additional aircraft plants



Timm Aeromold plastic is sprayed on strips of veneer before cross strips and another layer of lengthwise strips are layed and sprayed to build up 3-ply shell, which is reinforced to 5-ply around the cockpit section. This shell is then placed in a mold where heat and pressure are applied to impregnate the wood fibres with the plastic which bonds the strips of plywood and plastic into one solid piece.

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For Accurate HIGH PRODUCTION ETCHING

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A NEW GORTON DEVELOPMENT—"Spit-Fire" Electric Arc Etching—provides the answer to urgent war plant demands for an All-Purpose Production Etcher which *deeply etches hardened parts without burr in minimum time.* Now in use by largest companies.

MARKS GOODS IN FINISHED STATE at speed of 120 arcs per second with pantograph machine accuracy. Produces an etch improved in legibility, clean-finish and uniformity. Most efficient on highly polished or ground surfaces, large or small, or on delicate parts such as .0015" Feeler Gage stock.

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SIMPLE OPERATION—QUICK SET-UPS—Uses unskilled operator, man or woman. Etching is precision-controlled through pantograph tracing from master. Usually no preparation of work needed. Requires no acid, no pressure, stress or strain. Overcomes problem of metal fatigue—no fissures, no flaws result. Operates on 110 to 120 volts, 60 cycles AC only. Etching voltage, 3 to 9 volts. Current consumption 25 watts, maximum.

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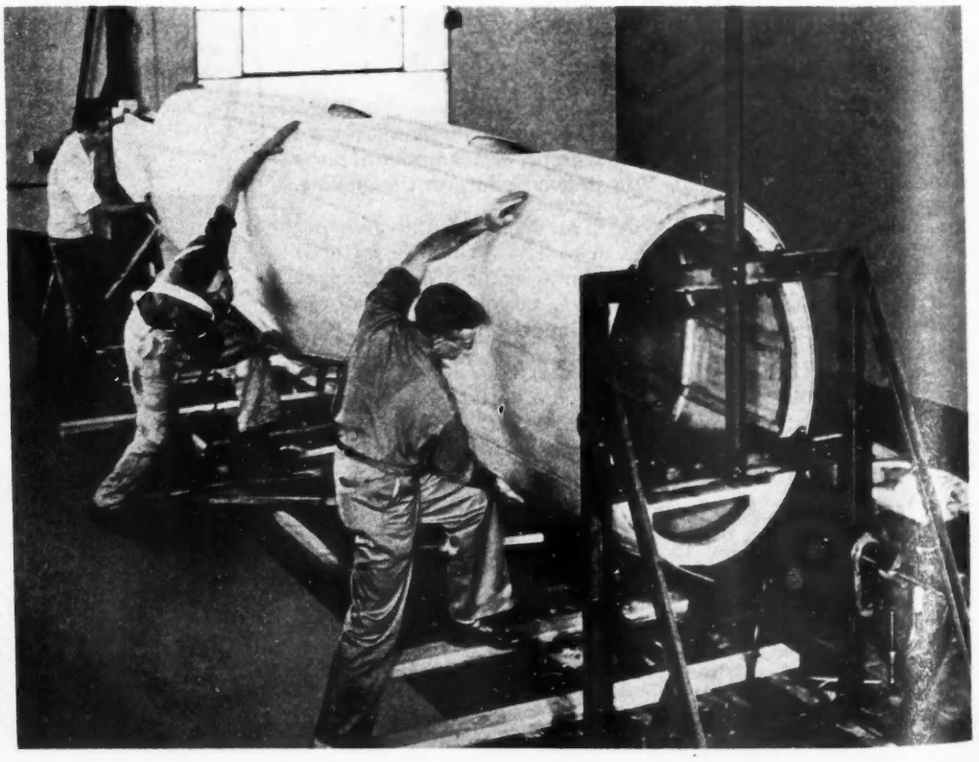


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Technical Aspects of



Sheet Metal Forming

By F. R. Shanley*

By close cooperation between shop and engineering departments it has been found possible to place the forming of sheet aluminum alloy parts on a sound basis of technical understanding and control, to predict the limits of formability of any material or particular type of part, and successfully to design form blocks and dies with relatively little need for subsequent reworking.

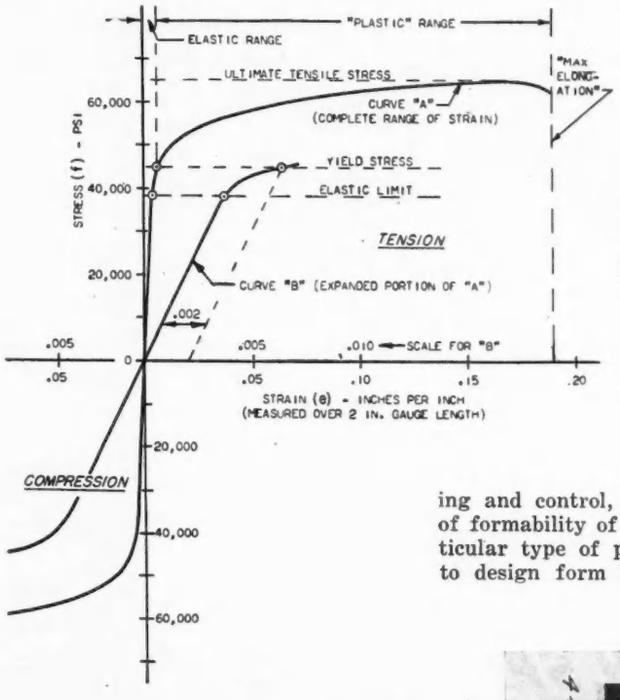


Fig. 1 — Typical stress-strain diagram (24st alclad).

DURING the past two years a concerted effort has been made at Lockheed to place the forming of aircraft sheet metal parts on a sound basis of technical knowledge and control. The reasons for this were twofold: first, the urgent need for quantity production made the old cut-and-try methods based on hand forming processes inadequate; and, second, the prevalent use of aluminum alloy materials, instead of the easily formed steels commonly used in the automotive industry, made it impossible to adopt ready-made the highly advanced technical methods developed in the latter industry. A careful study of fundamentals was necessary in order to bridge the gap caused by differences in material properties and types of parts to be formed.

Importance of the Stress-Strain Diagram

The engineering contribution to this effort was made largely through the studies of the Lockheed Production Research group. These studies were founded on the basic principle that the ordinary stress-strain diagram, suitably modified and extended, is the key to almost all forming problems. This means that there is really no mysterious or unique property which is a measure of formability. It is only necessary to extend our knowledge along lines already established.

An ordinary stress-strain diagram for 24ST Alclad material is shown in Fig. 1. Note that for curve "A" the strain scale is such as to cover the entire range to failure. In forming work it is important to have the "complete"

* Chief Structures Engineer, Lockheed Aircraft Corp. This article, prepared by Mrs. M. M. Rockwell, Lockheed Production Research Group Engineer, is based on Mr. Shanley's paper, "Elastic Theory as a Tool in Sheet Metal Forming Problems", which was presented at the 1942 annual meeting of the Institute of Aeronautical Sciences.

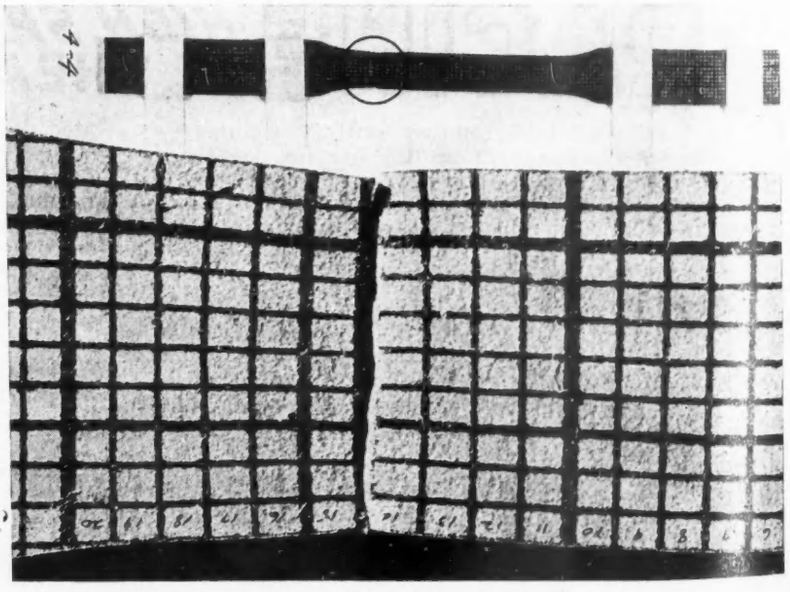


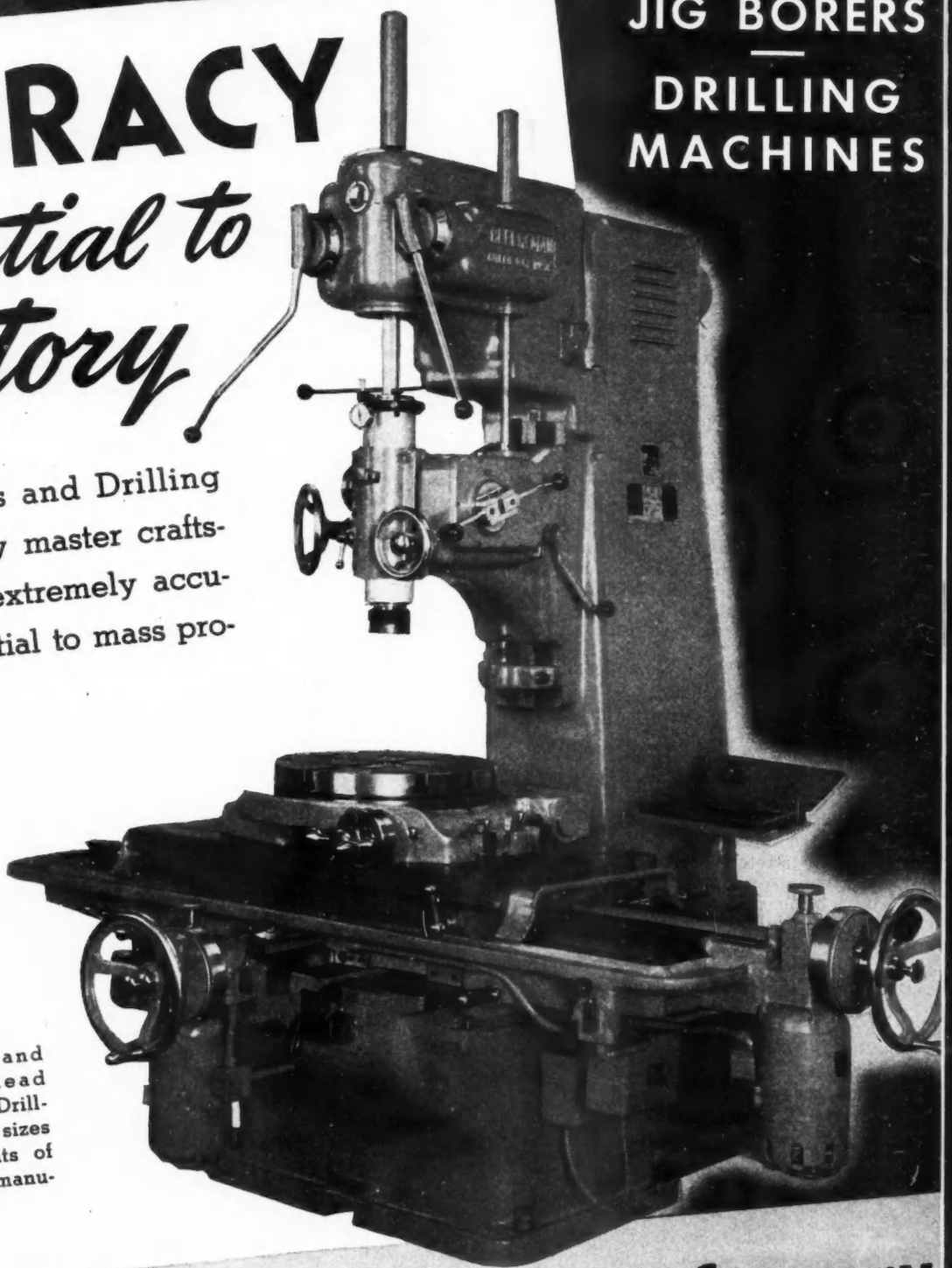
Fig. 2—Typical test specimen for measuring local strain.

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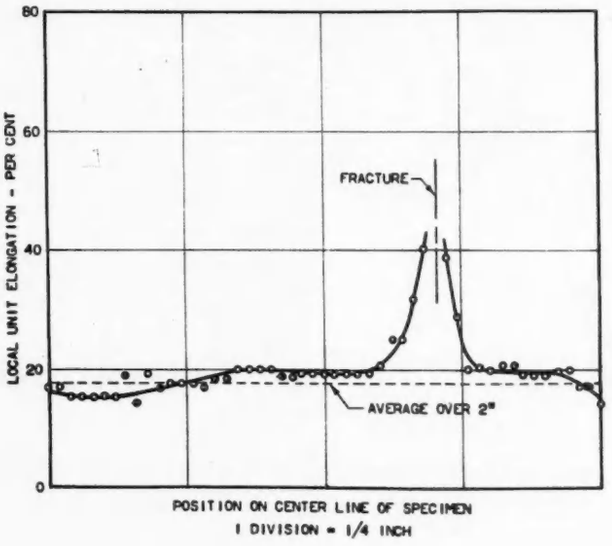


Fig. 3 — Distribution of elongation measured over 0.02 inch gage lengths, in a standard tensile test specimen of 24st alclad. * Reproduced from reference (1).*

stress-strain diagram for the tension range. Note also that the curve is extended some distance into the compression range. This information is often useful in dealing with buckling problems.

Maximum Elongation

The total strain just before the instant of failure represents the "maximum elongation" of the material, that is, the amount it can be stretched before breaking. For typical aluminum alloy materials (24ST Alclad) this value is in the neighborhood of 19 per cent. (See Fig. 1.) The standard measurement of elongation is made over a two-inch gage length in a tensile coupon held between grips which are about five inches apart. In forming work, however, the length being stretched may vary from a very small value (such as ¼ in. in the case of a sharp bend) to a large value (such as several feet in the case of a sheet being formed by stretching), and it was therefore necessary to determine the maximum elongations obtainable under these widely varying conditions.

The first studies were made as described in Ref. 1, by photo-printing a fine grid-work on a tensile specimen and measuring the actual strains occurring in very short gage lengths from an enlarged photograph or by means of a cathetometer (measuring microscope). A typical specimen is shown in Fig. 2. The results of such measurements were plotted against position along the specimen, showing how the strain varied locally just as fracture occurred. Fig. 3 shows such a curve. To obtain the total elongation over any particular length of the material, the *average* height of the curve over this length must be determined. By selecting various lengths (always including the point where fracture is about to develop) and performing this process, we obtain data for the type of curve shown in Fig. 4.

Knowledge of the allowable maximum elongations over various gage lengths has been found very useful in predicting limits of bending and stretching, as will be described later. It is hoped that in the near future, vendors of sheet metal materials will begin to furnish detailed information along the above lines. The "bend test" specification for steel is the closest current approximation to description of local elongation properties.

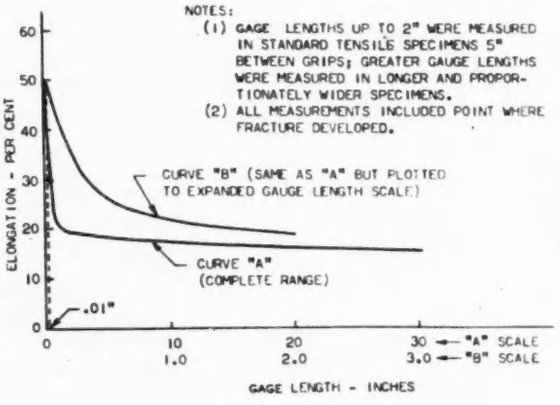


Fig. 4—Variation of maximum elongation obtainable with gage lengths over which it is measured.

Permanent Deformation

The usual stress-strain diagram represents a "one-way" loading to failure. Since forming operations involve going only part of the way to failure, it is of special interest to know the behavior of metals after the load has been released and, in some cases, after it has been applied again. This subject is well covered in Ref. 2. The most important points can be summarized as follows:

(a) During unloading, the stress-strain diagram is substantially "elastic" in nature, i. e., becomes a straight line having the same slope as the elastic portion of the basic diagram.

(b) Upon *reloading*, the new stress-strain diagram tends to follow the "unloading" line until it reaches the original basic curve, after which it follows that curve. (The fact that in general the new "yield point" is higher than that encountered during the original loading, is commonly referred to as the "strain-hardening" effect).

These points are illustrated in Fig. 5, which shows conditions for two successive loadings. Further unloadings and reloadings would exhibit the same general tendencies. Fig. 5 shows that if the loading is carried well into the "plastic" range the permanent strain will be large in comparison with the "springback" or elastic recovery. Hence the material will tend to remain in the formed condition. On the other hand, any loading condition which does not stress the material beyond the proportional limit (i. e., which does not go beyond the initial straight portion of the S-S diagram) will have a complete elastic recovery, and hence no permanent forming will occur.

Nature of Plastic Deformation

Evidence indicates that in the "elastic" region the deformation which occurs is a matter of distortion of the patterns of the molecules in their crystal arrangement, or possibly distortion of the orbits of the components within the molecule. In the "plastic" region, on the other hand, it appears that the deformation is the result of slippage along planes within or between crys-

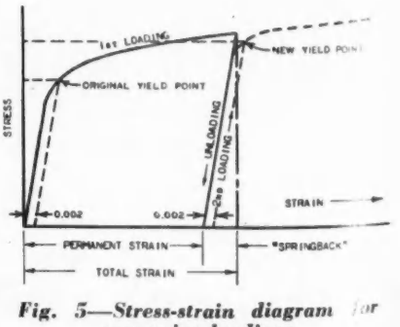
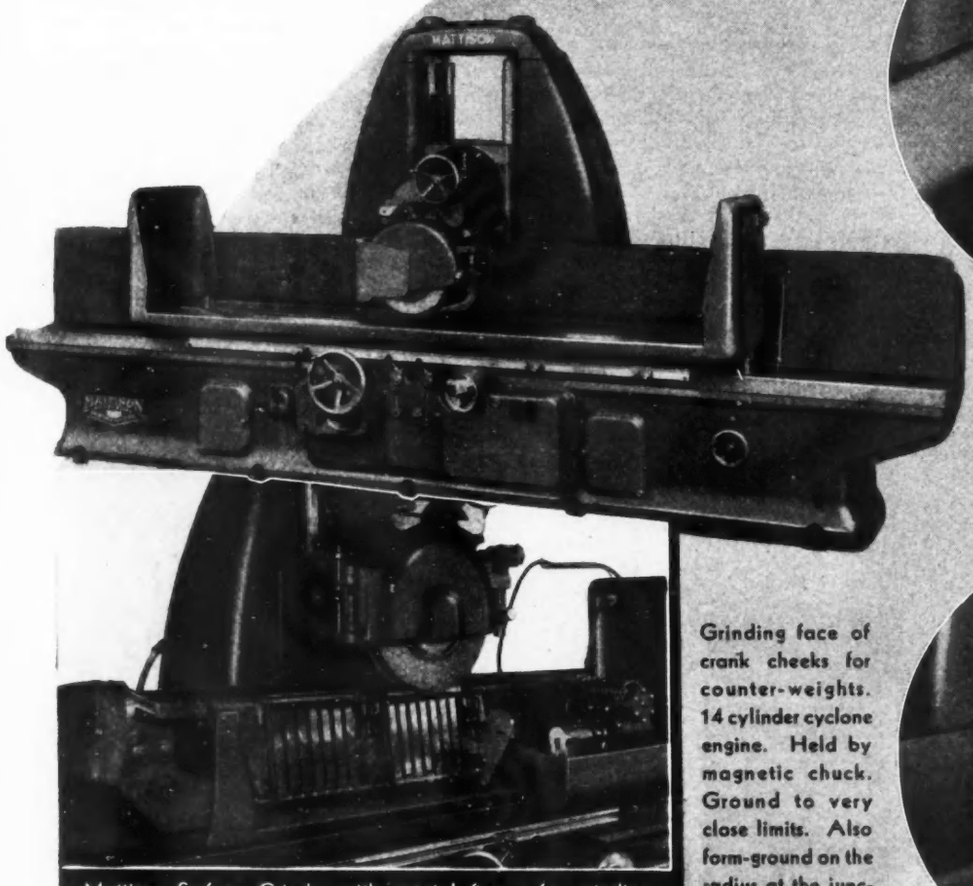


Fig. 5—Stress-strain diagram for successive loadings.

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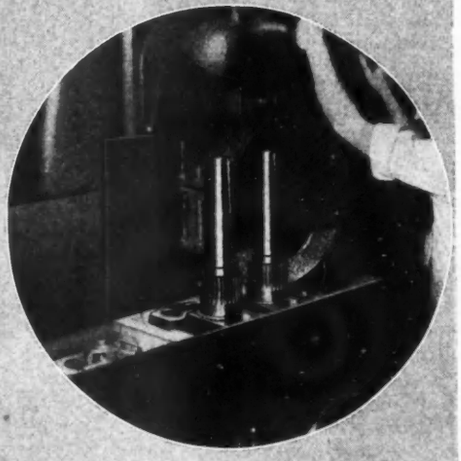
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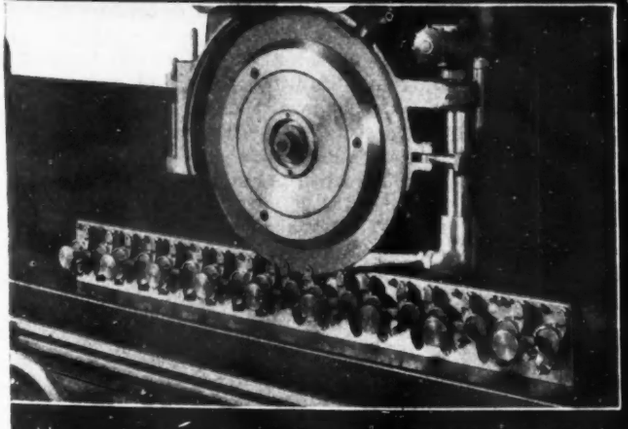
Mattison Surface Grinder with special fixture for grinding the radius at end of articulated rod. A formed wheel is used with the rods indexed for rough grinding; then the fixture is oscillated by power while the table reciprocates to finish-grind the radius, producing a fine finish and accurate radius.



Exhaust manifolds are finish-ground both sides to very close tolerances. Its ability to turn out work to close limits of accuracy at a high production output makes the Mattison Grinder ideal for finishing of aircraft parts.



Grinding face of crank cheeks for counter-weights. 14 cylinder cyclone engine. Held by magnetic chuck. Ground to very close limits. Also form-ground on the radius at the junction of the cheek with the body of the shaft.



Narrow slots in end of rocker arm are ground by Grinder. Special fixture allows holding these parts in accurate alignment while slot is ground. With this arrangement several pieces at a time are accurately ground.

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Mattison Surface Grinders have proven their value for use in the production of aircraft parts where close precision and high output are required. A few of the factors which account for the success of Mattison Grinders are, the massive double-column support for the wheel-head, high power for rapid stock removal, large table capacity, smooth double-cylinder hydraulic table-drive, simplicity of operation and highly accurate construction. Illustrated are a few typical aircraft applications of the Mattison Grinders at the Wright Aeronautical and Curtiss-Wright Plants.

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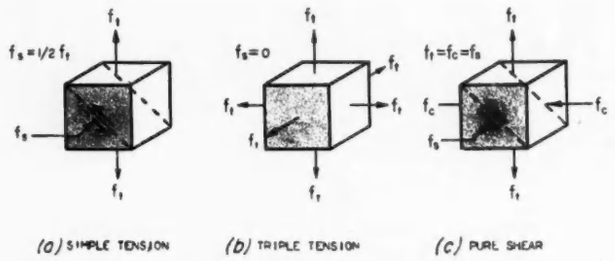


Fig. 6 — Fundamental stress conditions.

tals. This slippage, once having occurred, is irrevocable and "permanent set" results.

This is a very important fact because it explains how metals can be worked. In the case of a simple cube under tension, Fig. 6(a), the tensile stress f_t has components which act along any diagonal plane one may care to select, and the maximum component acts along the 45 deg. diagonal. (See Ref. 3 or any other good text on Strength of Materials.) When the load is increased to the "yield point," slippage first begins along these diagonal shear planes, as evidenced by the familiar "Lueder Lines." This diagonal slippage results in an elongation becoming noticeable in the direction of the primary tensile stress f_t, and it is this elongation which is plotted in the plastic region of the stress-strain diagram.

Increasing Plastic Deformation by Combined Stresses

In the case of simple tension just described, the maximum value of the diagonal shear stress is only half that of the tensile stress, hence failure due to lack of cohesive strength of the material under the direct tensile pull may occur before the shear slippage has progressed very far. Thus low "maximum elongation at failure" will result. However, there is a way greatly to increase the shear slippage forces without increasing the tensile stress tending to cause cohesive failure. This is by adding *compressive* forces acting perpendicular to the tensile forces, as shown in Fig 6(c). The compressive forces can readily be seen to produce a squeezing action which tends to cause the wedge-shaped halves of the cube to slide over one another along the diagonal plane. That is to say, they add to the *shear components*, f_s, acting to produce diagonal slippage. At the same time they do not tend to rupture the metal by any "pulling-apart" action. As a net result, slippage along diagonal planes will progress much further before the tensile stress f_t reaches the level necessary to cause rupture by overcoming the cohesive resistance. A stress-strain diagram such as shown in Fig. 7 is the result.

This combined stress action is the secret of all "deep-drawing" action. The latter will be discussed later. If compressive forces are added on the third pair of cube faces, and the tensile force reduced to zero, elongation in the direction of the latter will nevertheless occur by the "extruding" process.

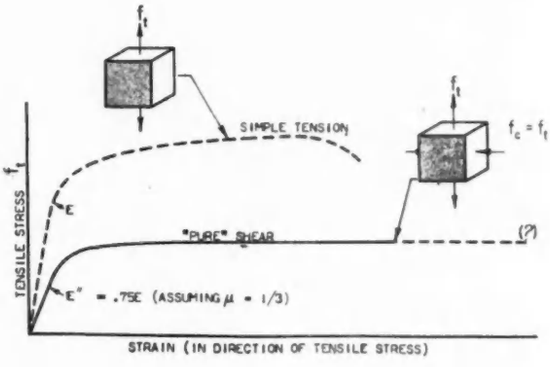


Fig. 7—Comparison of stress strain diagrams for combined compression and tension, and for simple tension.

Combined Stresses—Danger of Triple Tension

There is a reverse condition which is very dangerous from the formability standpoint. This is the condition of "triple tension" illustrated in Fig. 6(b). In this case all the diagonal components of stress can be shown to cancel one another out, and there is therefore *no* capacity for slippage. The stress-strain diagram would probably be a straight line (Fig. 8), ending in complete cohesive failure or disintegration at very low deformations. Such deformation as does occur would be a matter of volume change similar to the expansion of gas or water under decreased pressure. For all practical purposes the capacity for such volume change is zero in metals at room temperature; hence the *"triple-tension" condition represents a complete lack of formability.*

It will be seen from Fig. 8 that the area under the stress-strain diagram for the case of triple-tension is very small. This means that the capacity for absorbing energy is slight and impact resistance is correspondingly very low. A sharp notch in a tension specimen has the effect of building up a double- or triple-stress condition at the root of the notch, due to the restraining influence of the adjacent unstressed metal. This decreases not only the impact resistance, but also the ability to withstand static tension loading. Hence notches have a most adverse effect on formability as well as on ability to carry structural load.

Any combination of tensile stresses, even if only in two directions, or even if unequal, will tend to produce the undesirable effect described above, and should be carefully avoided in design. Many failures of forming processes may be ascribed to the unrecognized presence of a "double-tension" condition. For instance, it is well known that when metal is stretched in one direction it must contract in the other in accordance with Poisson's ratio. If this lateral contraction is prevented by some transverse gripping action of the dies, premature failure of the sheet is very likely to occur.

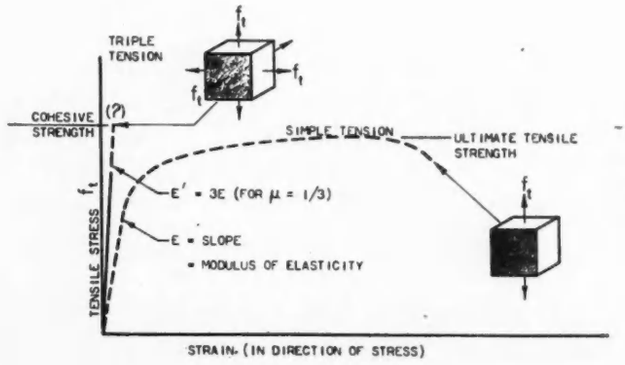


Fig. 8—Comparison of stress-strain diagrams for triple tension and for simple tension.

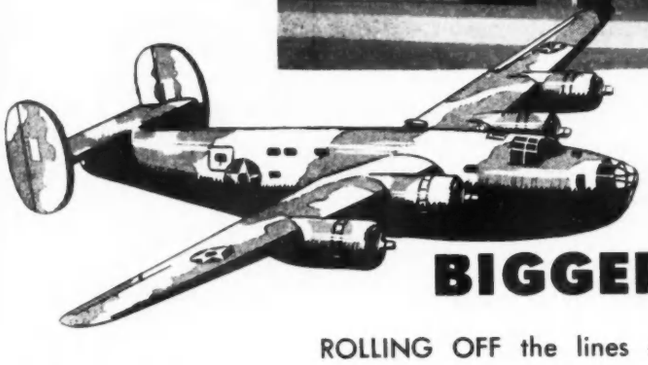
Practical Forming Processes

The foregoing discussion indicated the most important physical properties and relationships which affect the behavior of metals under forming conditions. Specific forming operations for sheet-metal will now be discussed. These comprise bending, stretching,

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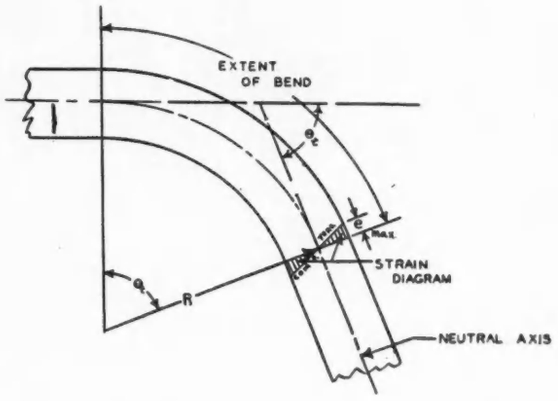


Fig. 9—Geometry of a bend.

compression ("shrinking") and drawing.

Bending

Simple bending occurs when the final (bent) surface is a "developable" one; that is, the bent portion must form a portion of a cylinder or a cone. Since this is one of the easiest types of forming that can be done, the designer should make every effort to use developable surfaces, if sheet-metal is involved. This point should be obvious, but actual experience indicates that it is often overlooked by the draftsman.

The two major problems in simple bending are *minimum bend radius* and *spring-back*. The first is of special interest in the forming of flanges and sheet-metal stringers. A large bend radius is usually structurally inefficient, as it leads to a wide flange which in turn causes lower buckling stresses under compressive loading. The problem of minimum bend radius was given special attention at Lockheed because of the conversion of a large number of aluminum alloy parts from forming in the SO (annealed) condition to forming in the ST (heat-treated) condition. The minimum bend radii applicable to the heat-treated material were determined very accurately in order to learn whether the original form-block radii could still be used. The work was done primarily by actual test, but it was found that the minimum radii could be very accurately *predicted* on the basis of the maximum allowable elongation for the length of material involved in the bend. Following is a brief description of how this is done:

Determining Minimum Radius

Fig. 9 shows the geometry of a bend. Approximately midway of the material will be a neutral axis or plane wherein neither stretching nor compression occurs. Inside the neutral axis the material is compressed; while outside the axis it is stretched, the maximum strain (elongation per unit length) occurring at the outermost fiber. This maximum strain is equal to the thickness divided by twice the radius to the neutral axis (in mathematical symbols, $e_{max} = t/2R$).

Cracking will occur if e_{max} exceeds the allowable elongation of the material *determined for a gage length corresponding to the bend allowance* or distance over which the bend extends. This allowable elongation may be obtained from Fig. 4. Since in ordinary sheet metal bends the bend allowances are of the order of ¼ in. to ½ in., data on the allowable maximum elongations in these short gage lengths are needed in order to predict minimum bend radii. Curve B of Fig. 4 shows that such "local" elongations are considerably higher than the maximum elongation determined for the standard two-inch gage length.

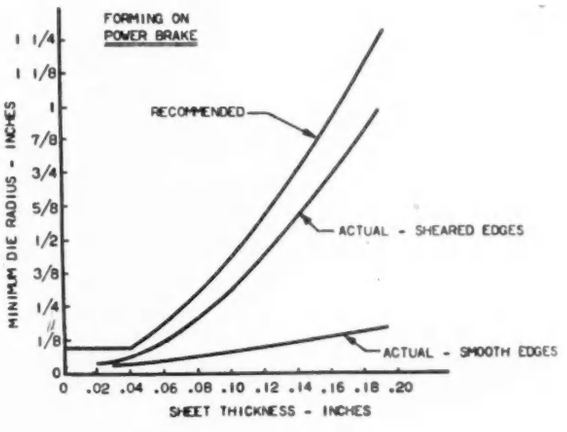


Fig. 10 — Minimum bend radii for various sheet thicknesses (24st Alclad).

Extensive and careful checking have shown that minimum radii can be predicted very accurately on the basis of ¼ in. or ½ in. maximum elongation values. Hence it is desirable that vendors of sheet metals should furnish this information regarding their product.

Fig. 10 shows minimum radii for 24ST Alclad material, based on extensive test work. The values were taken on the power brake and will be conservative for the hydro-press. When edges are rough due to shearing operations, the minimum radii have to be very much greater than when they are smooth, as from routing operations or after de-burring. The *calculated* minimum values check the "smooth edge" condition very closely, although in some cases allowance has to be made for the fact that the strain distribution in a bend is actually somewhat non-uniform in nature, as shown in Fig. 11.

Repeated flexure tests of some of the bends of minimum radius showed that no danger of subsequent fatigue failure exists if cracking does not occur on the original bend. Even small cracks on sheared edges showed no appreciable tendency to spread during the test.

Springback

The other important problem involved in simple bending is the tendency of the sheet to return toward its original flat shape when the forming pressure is removed. This is called "springback." Springback is usually thought of in terms of the change which occurs in the flange angle when pressure is removed, but there is a corresponding change in radius, which also often causes difficulties. No matter what the angular position of the bent piece shown in Fig. 9, the distance along the *neutral axis* is unchanged, since it is always equal to the original length of the sheet. This distance is equal to the radius times the arc ($R\,\theta_t$). Hence $R\,\theta_t$ is constant, and if during springback θ_t decreases, R must increase in inverse proportion.

In the past, springback was allowed for by the form-block makers on the

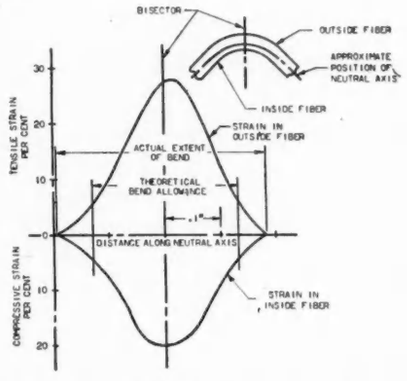
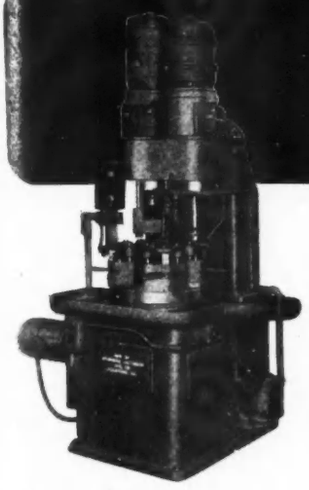


Fig. 11—Strain distribution in a typical bend.

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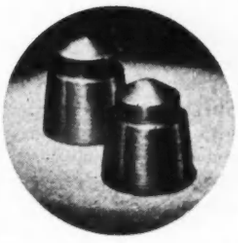


SHOT CAP MACHINE

This four-position, two-spindle vertical machine performs the finishing operations on 37 mm. A.P. Shot Caps. The first spindle completely finishes the top profile of the cap, including the point and undercut, with an inserted-blade hollow milling tool. The second spindle automatically threads the cap, using a chaser-type die head with a precision ground lead screw.

180 PER HR.

Capacity of this machine is 180 pieces per hour, requiring one operator to load and unload the work at the two front stations. Proper synchronization of operations is obtained with suitable interlock. Illustration shows unfinished and finished cap.



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SOLDER WIPING MACHINE

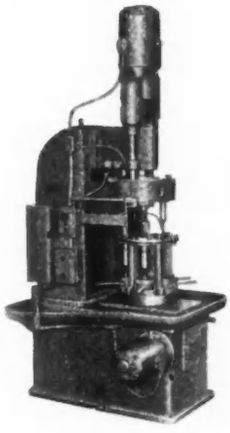
This machine assembles shot and cap with a wiped solder joint, excess solder being removed by a brush. Operation is continuous and automatic, the wiping action providing a firm joint with exclusion of all air bubbles and oxidation. The machine requires about six feet by seven feet of floor space and has two motors totalling 5 horsepower.

1200 PER HR.

Capacity of this machine is 1200 assemblies per hour. Three operators are required —one to load the shot, one to load the cap, and one to remove the completed assemblies. Illustration shows the cap and shot separate, and the assembled unit.



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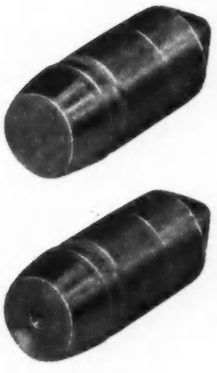


TRACER HOLE MACHINE

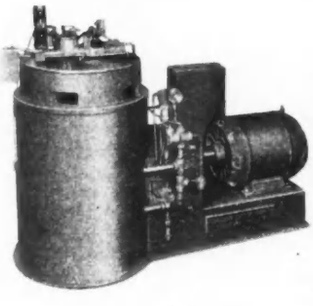
This is a five-station, vertical, automatic-indexing machine for drilling, reaming, and countersinking the tracer hole in 75, 57, 40, or 37 mm. A.P. shot. The sequence of operations is (1) Unload and load, (2) Drill half way, (3) Drill from half way to depth, (4) Ream to depth, and (5) Countersink. The drilling is done in two steps to increase production and reduce drill breakage and wear. The reaming spindle has individual feed to give it twice the travel of the drilling spindles. One machine can, with minor modifications in the fixtures, be used for any of the four sizes of shot listed above.

240 PER HR.

Capacity of this machine is 240 holes per hour. One operator is required, to load and unload the work. All operations are fully automatic and properly interlocked for protection. Illustration shows a 75 mm. shot before and after the tracer hole is drilled.



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SHELL BANDING MACHINE

This machine squeezes the band onto the shot and will handle shot from 20 mm. to 75 mm. size at various production rates depending on the number of squeezes necessary to give a thorough penetration of the band into the serrations. When more than one squeeze is used, the piece is indexed between squeezes to permit uniform metal flow and prevent crystallization. Pressure can be regulated to suit a variety of conditions.

600-1200 PER HR.

Capacity of this machine is 1200 20 mm. shot or 600 37 mm. shot per hour. One operator is required, to drop the shot and band into the "nest". Illustration shows shot and band, and the assembly.



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basis of their empirical knowledge, and this was quite sufficient in forming parts of annealed (SO) stock, where springback is only of the order of 2 or 3 degrees in most practical cases. However, when the forming of heat-treated (ST) stock was attempted, springback was found to be much greater and serious shop difficulties were encountered. To overcome these, empirical data were gathered (the results of which were published in Ref. 4). Also, an analytical method of calculation was developed which has proven capable of checking the test results very closely, and is most useful where it is desired to determine in advance the springback properties of new materials not available for test.

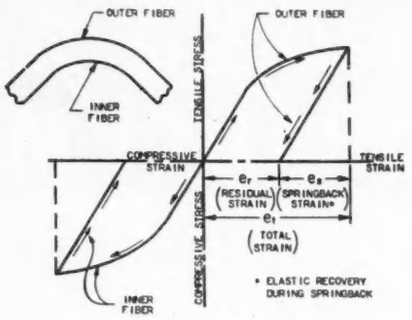


Fig. 12 — Stress-strain conditions during bending (outer fibers).

Springback Calculating Method

The principle upon which springback calculations are based is indicated in Fig. 12, which, for simplicity, considers only the outermost fiber of the bend. It also assumes that the neutral axis is in the middle of the sheet, and that the compression and tension halves of the stress-strain diagram are equal. These simplifying assumptions are sufficiently accurate to illustrate the principle involved.

Actually the conditions are not quite so simple as described, because the other fibers between the outermost one and the neutral axis must be taken into account. By the geometry of the bend (see Fig. 9), each must have a strain proportional to its distance from the neutral axis. Therefore the strains in these fibers must at all times preserve the same constant ratio of proportionality.

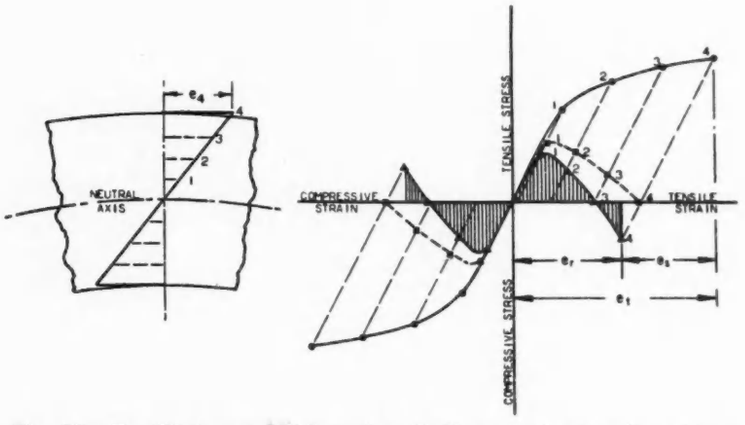


Fig. 13—Equilibrium conditions for all fibers during bending (showing conditions after springback).

In Fig. 13 we consider five different fibers, starting with zero at the neutral axis and equally spaced. If the sheet is bent to cause a total strain e_4 at the outer fiber, the inner fibers will be uniformly spaced along the S-S diagram as shown. Now if upon removal of the forming force each of these fibers returned to a condition of zero *stress*, along the respective elastic recovery lines, the intercepts along the horizontal axis would not be uniformly spaced and hence proportionality of strain would no longer exist. Hence the simple method of considering only the outer fibers must be regarded as a round approximation.

The final state of the bent member must comply with two conditions. First, the strains must remain linear, i.e., the projections of points 0 to 4 must remain *evenly spaced* on the strain scale. Second, the final internal stresses must represent a resultant bending moment of zero. If we make the assumption that the outer fiber (point 4) returns to zero stress (as was done in Fig. 12) and then divide the corresponding strain into four equal parts, the stresses in the intermediate fibers would be as indicated by the squares on Fig. 13. Each of these residual stresses would have a moment arm equal to its distance from the neutral axis. Hence together they would produce a bending moment tending to flatten out the sheet.* The residual stresses in the compression half of the diagram would act in the same direction.

The only way to overcome this effect would be to move the curve down into the lower position indicated by the triangular points. Here the outer fibers are actually in compression, and the algebraic sign of the residual stresses

* Note on Fig. 13, that the projection of each point on the horizontal axis represents *strain;* but since by the geometry of the bend strain *must* be proportional to distance from the neutral axis, it can also be said that projections on the horizontal axis are proportional to *distances* from the neutral axis. Hence the moment arm of each residual stress in Fig. 13 may be visualized as being proportional to its distance from the vertical or stress axis.

In Fig. 13 we consider five different

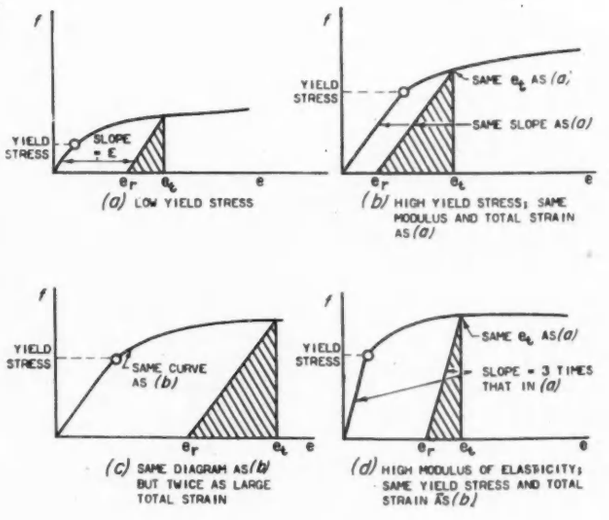


Fig. 14 — Effect of shape of stress strain diagram on springback, e_t-e_r = Springback strain."

As the bending force is applied, the outermost fiber follows the regular tensile stress-strain diagram to the point of maximum bending strain designated by e_t. When the bending force is removed, "elastic recovery" to zero stress occurs along the line parallel to the original straight-line portion of the curve. A residual strain e_r remains, and the angle of bend (Fig. 9) adjusts itself to such a value that the outermost fiber stress e_{max} is equal to this residual strain e_r. Thus in order to end up with a desired flange angle it is necessary to "over-form" the part by undercutting the form block to compensate for the springback. In some cases, such as large parts having a shallow contour of large radius, the change in the latter must also be allowed for in form block design.



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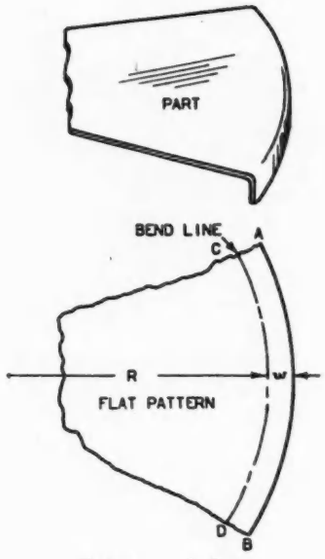


Fig. 15 — "Shrink" flange.

in this region will be opposite to the sign of the residual stresses in fibers such as 1 and 2 closer to the neutral axis. Opposing bending moments will therefore be created, and equilibrium will result. The outer fibers having longer moment arms than the inner ones, only a small degree of entry into the compression region will suffice to produce equilibrium. The final criterion is, that the shaded area under 3-4 times the distance of its centroid from the vertical axis, must be equal to the shaded area under 1-2 times the distance of *its* centroid from the neutral axis. A cut-and-try graphical solution may be made for this condition, or an analytical solution is also possible. It should be noted that the residual strain in the outer fiber, determined by this method, is appreciably less than that obtained from the approximate method where the internal fibers are neglected; hence calculations by the former method will indicate too small a value of springback.

The above theory was developed at Lockheed by E. I. Ryder† in 1940, and has been thoroughly verified by checking against empirical data. A typical curve found from experiments is given in Ref. 5 and agrees quite well with the above theory. For great accuracy some allowance has to be made for non-uniform strain distribution around the bend, and for shift of the neutral axis from its assumed central position. In the latter case the summation of moments has to be made zero across the entire section, instead of merely within each half. Reference 6 also gives an interesting discussion of springback, using a somewhat different approach applicable particularly to extrusions and other structural shapes.

Effect of Physical Properties on Springback

An interesting comparison of springback effects resulting from various shapes of stress-strain diagrams is shown in Fig. 14. The approximate method, considering only outer fiber strains, is sufficiently accurate for such a comparison.

The difference between e_t and e_r represents the loss in strain due to springback, and the less this difference is, compared to the total strain e_t imposed during forming, the less will be the springback after the forming force is removed. Hence the ratio $(e_t-e_r)/e_t$ may be considered a sort of criterion of springback.

It is seen that in case (b) with high yield stress, springback is very high compared to case (a) with low yield stress. This is why the hard-temper materials are difficult to form. Case (c) shows springback decreased as compared with (b) simply by deforming the metal further. This greater deformation may arise from greater sheet thickness, since the strain required at the outer fiber for a given bend is proportional to thickness

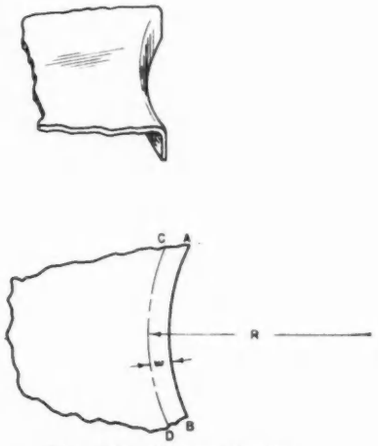


Fig. 16—"Stretch" flange.

($e_{max}=t/2R$). Thus for a thick sheet condition (c) may apply and the springback be much less than for a thin sheet where deformation corresponding only to condition (b) is reached. Also, if the bend is of very large radius, insufficient deformation may be obtained to produce any residual strain at all, and stretching may have to be resorted to, as described later. Case (d) shows how increasing the nodules of elasticity decreases the springback.

Bending of Curved Flanges— Shrinking and Stretching

If the bend-line for a flange is not straight, the bending of the sheet will introduce stretching or compression effects in the mid-plane. This is illustrated by Fig. 15, which shows the flat pattern for a typical part before bending. This type of flange may be called a "shrink" flange, as the free edge AB must be made shorter as the flange is bent to its final position immediately below the bend-line DC. Fig. 16 shows a "stretch" type of flange, in which the free edge must be lengthened during the bending process.

If we assume that the length along the bend-line CD does not change, the strain (unit change in length) of the free edge will be given directly by the ratio w/R:

$$e = \frac{w}{R+w} \simeq \frac{w}{R}$$

In the case of a "stretch" flange, the above equation may be used to compute the tensile strains in the free edge. These must then be compared with the maximum permissible strain for the material, with proper allowance for the length involved (Fig. 4). On this basis it is possible to predict, for a given material, the limiting value of w/R, above which cracking of the free edge will occur.

For 24SO and 24ST aluminum alloys the amount of stretch that may be used in the above equation will vary from 10-22 per cent for 2-in. lengths and from 25-40 per cent for ¼-in. lengths. The higher values are obtainable under ideal conditions, while the lower ones are more suitable for high production.

After a curved flange has been bent to shape, the stretch that occurs in the free edge will cause a secondary springback effect which tends to "bow" the flat portion of the part. This can be explained and predicted by the same principles used in the analysis of ordinary springback.

"Shrink" flanges (Fig. 15) involve compressing the free edge of the sheet. There will therefore be a tendency for the sheet to buckle as a column. It has been found that 24SO material can be shrunk about 6 per cent in the single-acting hydro-press using a form block and a rubber platen. 24ST can hardly be shrunk at all under such conditions, as the rubber does not give sufficient support against buckling. In general, thick sheet can be shrunk more successfully than thin sheet, because it has greater resistance to column failure.

Cut-Outs and Dishes

A common method of avoiding the buckling of shrink flanges is simply to cut out pieces of material, thereby permitting the shortening of the flange edge without building up appreciable compressive stresses. Another way is



Fig. 17—Treatment of "shrink" flanges by dishing.

† Now a member of CAA technical staff.

to form the buckles into the sheet as a deliberate design feature, a process which might be called "crimping."

A different approach to the problem has recently been developed at Lockheed. This consists in "dishing" the flat part of the sheet as shown in Fig. 17. Details of this method have been published in Ref. 7.

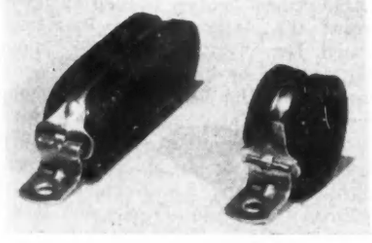
Special machines have been devised to facilitate the forming of flanges and other parts which undergo shrinking. These usually work on the principle of *progressive forming*, in which the compression of the sheet is done over very short lengths, hence does not cause buckling. Other methods, such as dies and draw rings, use the principle of *supporting* the sheet against buckling during compression.

This article will be completed in the October 15th issue of AUTOMOTIVE AND AVIATION INDUSTRIES.

Carbide Dies and Mandrels

CARBIDE dies and mandrels, produced by the Carboloy Co., Inc., Detroit, are now being used for drawing steel tubing as small as 0.013 in. (for hypodermic needles) and as large as 3½ in. Even larger sizes are now possible with the provision of suitable equipment for the manufacture of large-diameter dies and mandrels. Advantages claimed for carbide mandrels and dies over the steel and chrome-plated varieties, include longer die and mandrel life, higher drawing speeds, and lower cost over the life of the die.

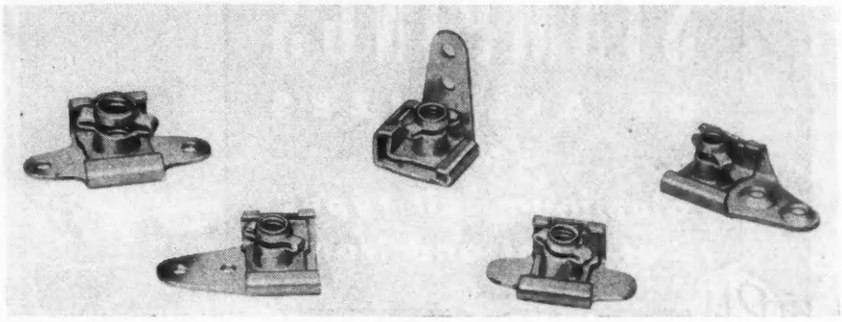
Electric Harness Clips



Adel Precision Products Corp., Burbank, Calif., is now in production of two new electric-harness clips with a special latch which permits the clips to be temporarily fastened to a group of wires at the desired location during sub-assembly of electrical harness. The clips can be quickly bolted down later in final assembly. The latch speeds sub-assembly work and acts as a safeguard. Type D-601 (left) is designed for holding three or more wires in parallel position. Type D-603 (right) will secure large groups of wiring of various sizes. Wires are cushioned in the clip with Adelite synthetic rubber insulating material to prevent chafing



Boots Floating Type Anchor Nuts



THE floating-anchor nut of the Boots Aircraft Nut Corp., New Canaan, Conn., is a combination of the regularly available channel nut with a specially designed base. This combination permits the channel nut to be used for specific anchor-nut applications where "float-accommodation" is desirable. The nut may be snapped in and out of the base just as it may be snapped from the regular gang channel.

Floating one-lug, two-rivet nuts, floating right-angle nuts, and floating plain anchor nuts are available. The base in all cases is finished with regular rivet holes, with dimpled countersunk rivet holes, or with a plain welding base, as desired. Government authorities are said to have approved the use of Boots floating anchor nuts for welding, because the nuts are removable. The floating nuts, made of cadmium-plated steel, anodized aluminum, or stainless steel, are both plain and countersunk, 82 per cent or 100 per cent. The bases also are offered in the three metals mentioned, and any combination of nut and base can be made.

The Aircraft Industry Is Doing Its Job

(*Continued from page* 102)

subsidiaries, headed by the Fisher Body Division. The Government-owned bomber assembly plant, which is operated by North American in Kansas, is the focal point of a coordinated production plan involving North American and this group of General Motors' subsidiaries. The plan as originally put in motion involved the supplying of subassemblies by the Fisher Body Division for assembly in the Kansas plant.

In order to put the aviation plant into operation while the automotive plants were preparing their facilities for production, North American supplied the Fisher Body Division with 100 sets of detailed parts (the equivalent parts necessary to make 100 B-25 bombers). These parts were completed in North American's California plant. Thus the Fisher organization was able to make delivery of actual assemblies at the Kansas plant long before the General Motors plants were prepared to fabricate parts independently.

Meanwhile, North American has furnished the Fisher organization with complete specifications and drawings on the B-25, and complete tooling data and drawings. The aircraft company also transmitted the "know-how" directly to Fisher tooling and production men who visited the California plant of North American in considerable numbers. Liaison between the two companies was effectively handled through liaison groups established in all plants.

At my own plant (Douglas Aircraft Co.) we early realized that secret tooling methods and production processes would have to go by the board if we wanted to give America the warplanes necessary for victory. So we turned over to various outside manufacturing companies details of tested airplane designs, tooling methods and production processes which were the culmination of years of development and millions of dollars in research costs.

As a result, such firms as Murray Corp. of America, Briggs Manufacturing Co., Pullman-Standard Car Manufacturing Co. are in production of wing sections, tail groups, engine nacelles and other major units for our bombers and military transports. Sub-assemblies constructed at their factories are shipped across the continent in specially designed railroad "shuttle" cars to our California plants for assembly.

How these firms bridged the gap between automobile and airplane manufacture, gave their personnel the necessary transition training and adapted their manufacturing facilities, is not only a new chapter in the history of industrial technique, but a dramatic instance of one great industry's quickly and efficiently schooling another.

At our plants all possible engineering and technical assistance in setting up assembly lines and solving production problems was given. Refinements and details of our production methods were explained and made available to scores of visiting automotive engineers who came to study first-hand the mechanization of aircraft production. We turned over, among many other things, to the automotive sub-contractors, a new system or three-way perspective production illustrations, our method of flush-riveting with a rivet of 100° head, also the Guerin hydropress process.

When Edsel Ford, President of the Ford Motor Co., and Charles Sorenson, Ford Production Manager, visited our plants, they studied with interest our development and use of three-way drawings in actual perspective which show to the untrained worker in a clear and simple way exactly what he is to do and how to do it. Ford asked and was granted permission to adopt this system of production illustrations for his company's new aeronautical division.

Under the supervision of our company's educational department, hundreds of factory foremen, shop supervisors and executives from these outside companies were trained in our plants in aeronautical processes and were acquainted with every detail of shop practice and assisted in organizing efficient courses of instruction for workers in their own plants. Among the automotive representatives who came to our plant for such purpose was the Ford Motor Company's Director of Personnel and Education.

These are but a few of the many instances whereby the aircraft industry has not only done its part in building planes, but at the same time has made it possible for other great industries to learn the art of warplane building and thus help swell the tide of planes which will eventually blacken the skies of Nazi Germany and will make the Rising Sun a fallen one.

The builders on the Pacific Coast are proud of the fact that we are producing considerably more than half (by weight) of the airplanes now taking to the air. We feel certain that our production record has been aided by formation of the Aircraft War Production Council, Inc. The policy of the Council is determined by its Board of Directors, composed of the heads of the member companies. These men are Harry Woodhead, Consolidated; Robert E. Gross, Lockheed; J. H. Kindelberger, North American; La Motte T. Cohu, Northrop; T. Claude Ryan, Ryan; Courtlandt Gross, Vega; Vultee represented on the Board by Mr. Woodhead, and myself.

From the outset the Board aimed at attaining more airpower per hour. Unity of thought, purpose and action has been the keynote of the Council. Its members have dedicated themselves and their plants to that, and that means production.

To attain the tops in production, eight functional committees of the Council work on specific problems. They cover the fields of Production, Materiel, Engineering and Standards, Transportation and Housing, Accounting, Plant Defense, Industrial and Public Relations, and Industrial Training.

Armed with the power to make

prompt and immediate decisions, these committees, composed of top men in every case, are able to cut through red tape and obtain results. The companies exchange every type of materiel when necessary to relieve shortages and maintain production.

A concrete example of such exchange took place early in August. A plant building particularly important planes had a complete breakdown of their stabilized hoist and bridge over the salt heat treat process equipment, used primarily for heat treating aluminum. Repairs could not be made without complete dismantling and rebuilding of the equipment which would take at least a month. That would mean a serious production situation in the plant.

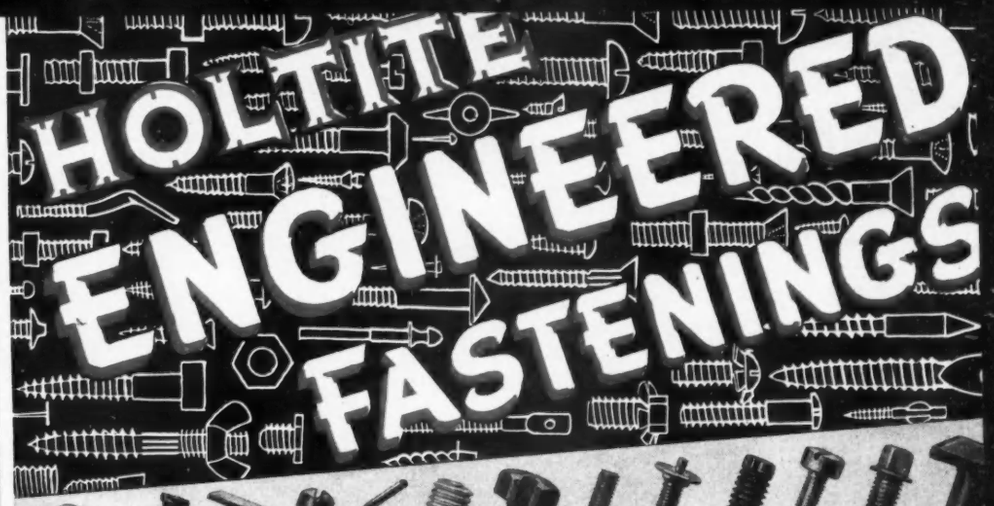
The plant manager telephoned the manager of another member company plant for help. As it happened, several new units of this particular equipment were ready to be installed at the other plant. So, one of them was immediately loaned to the plant in trouble, and a very critical situation was saved—and production of planes continued.

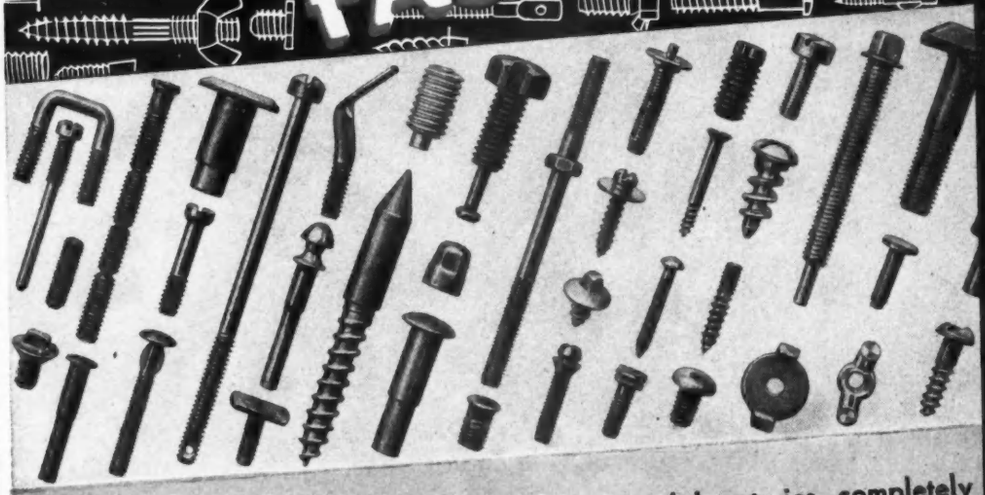
During the months of May, June and July, 1942, the member companies have made 3248 exchanges of materiel. Each exchange has been made to avert a potential bottleneck or shortage in materials that might slow down production. Two hundred and eighty-three engineering reports have been exchanged between the companies, and 493 library references to technical problems also were exchanged.

The Advisory Committee on Production has worked out 55 new procedures for speeding plane production. The committee meets regularly to consider ways and means for not only keeping production at a steady rate but also for increasing the output of the assembly lines.

In the field of aerodynamics, a Council company opened its records on such important matters as cooling tests, vibration, fuel system, vapor locks, flight tests and flying characteristics of all its models. Another company passed on all its findings on zinc chromate caulking, turnbuckle compression tests, bending tests of aluminum alloy, weld specimens, windshield tests, shear tests, vibration tests, spar tests, torsion tests and hundreds of others.

Engineers are loaned in times of emergency. One member plant does a necessary job of work for another plant when equipment breaks down. And the rule is that there shall be no profit on any of these work jobs. The member company is merely charged actual cost. When new problems in engineering arise, pools of information are formed. A problem is broken down into eight parts, and engineers from each member company work on the parts assigned to them. Thus precious research time is saved. All this information is available to any company in America building warplanes for the United Nations. This is one of the reasons that the aircraft companies can say the aircraft industry is doing its job.





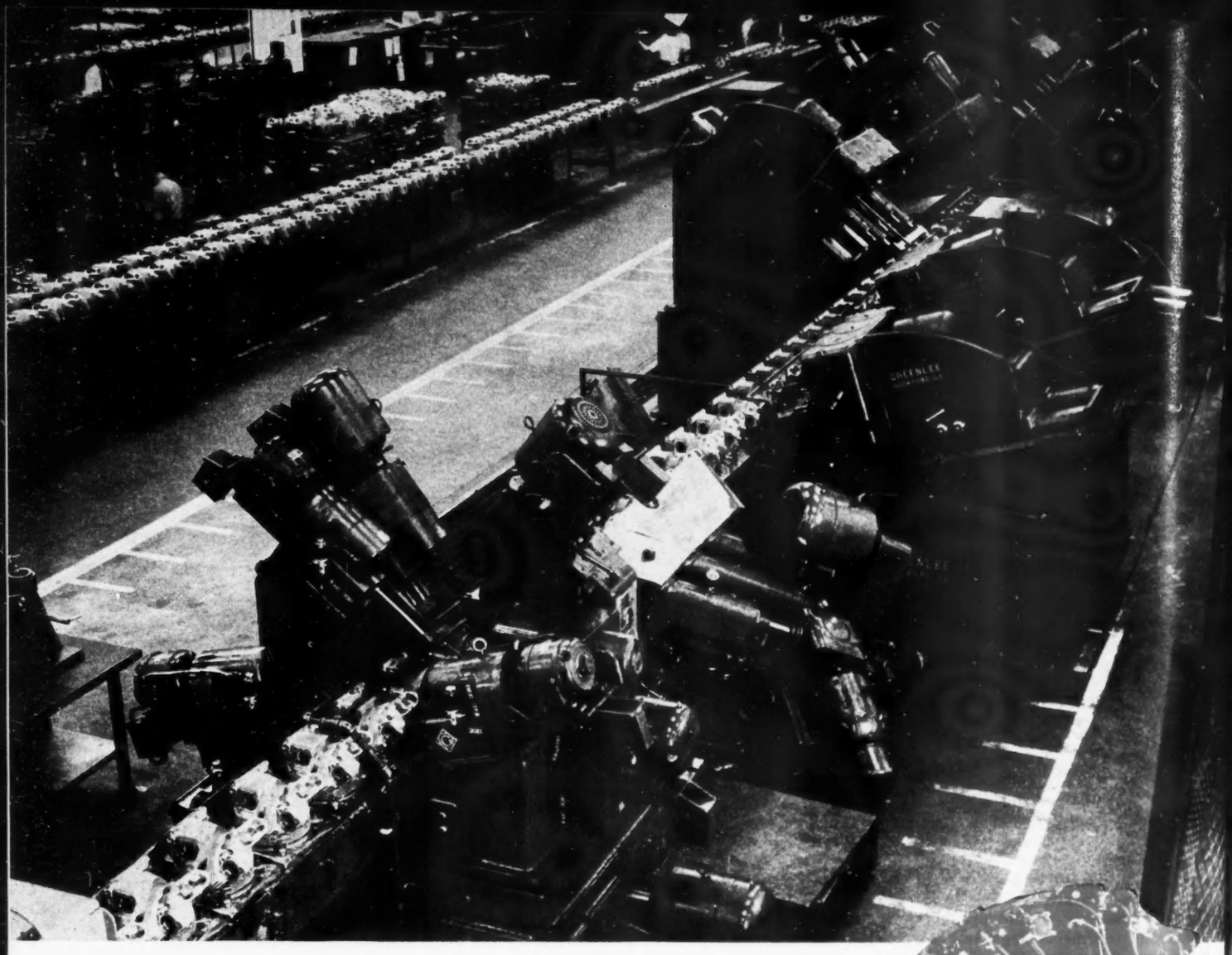
From blueprint, to laboratory, to mass production—each step an engineering achievement—HOLTITE Screws, Bolts and Allied Fastenings are designed and produced with the uniform precision of small tools.

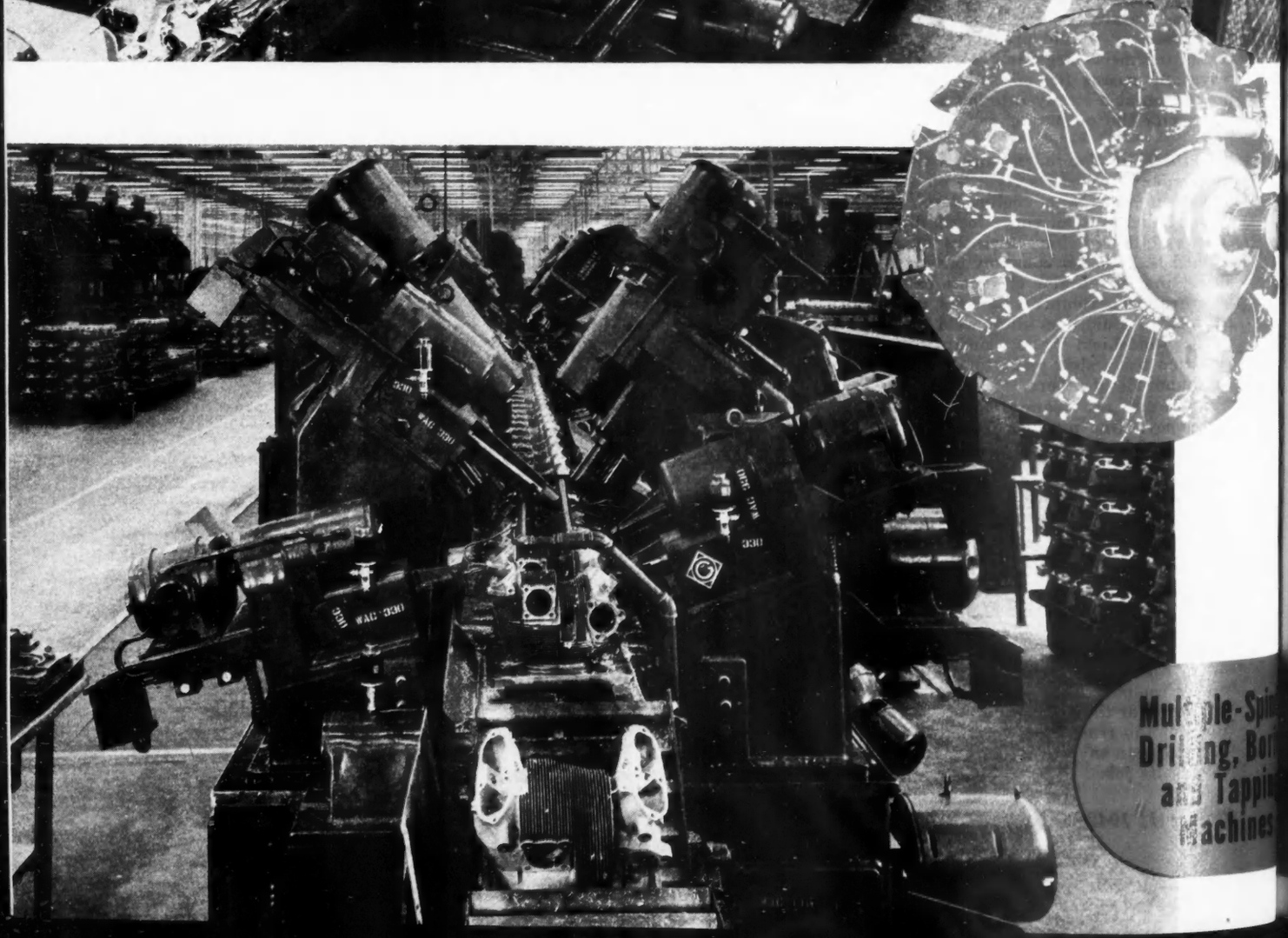
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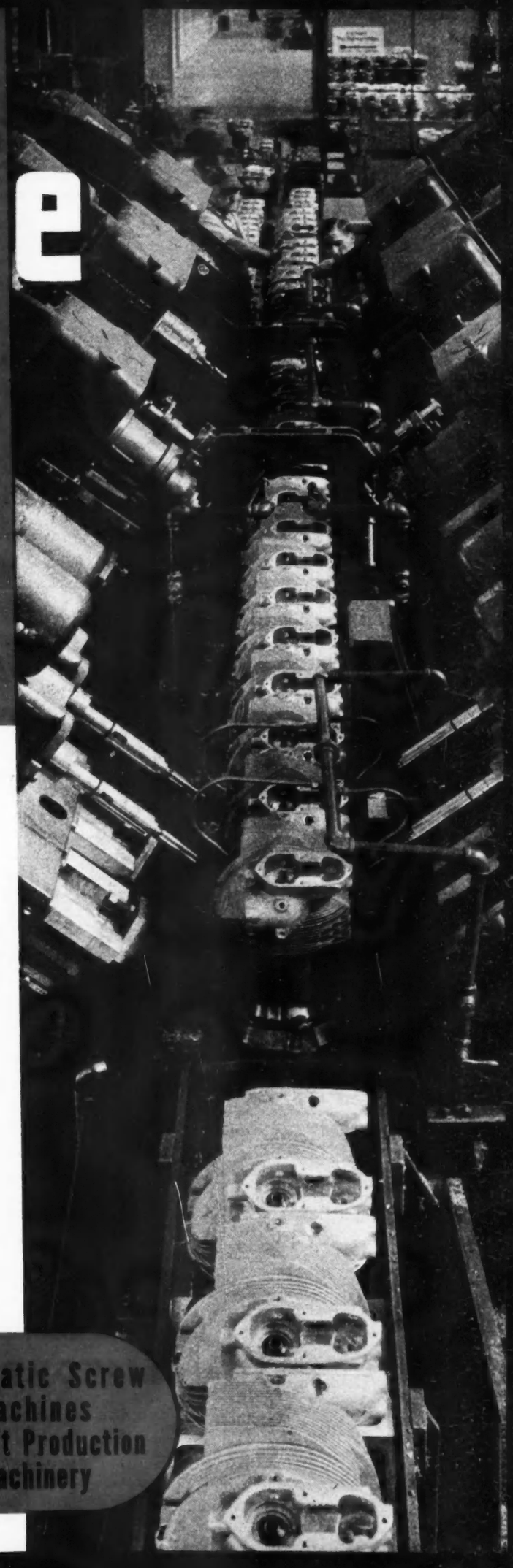
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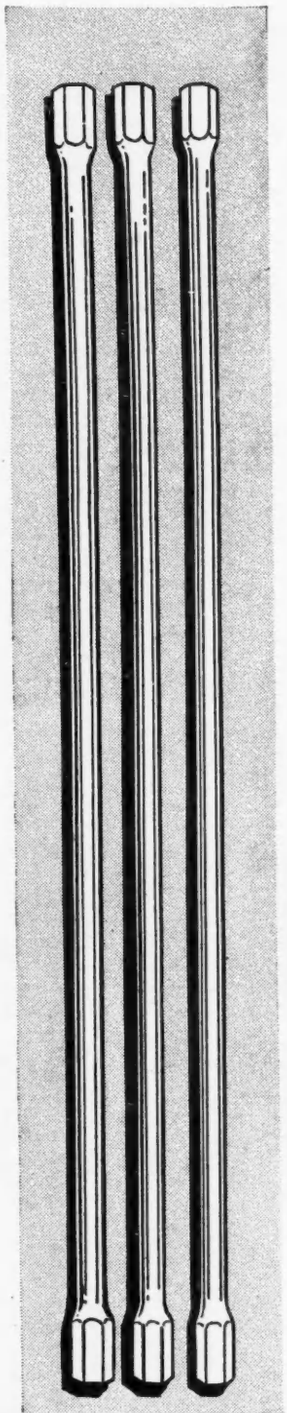
The giant Greenlee Multiple-Station, Straight-Line Automatic Transfer Machine shown here, is part of a battery of Greenlee Special Equipment now at work machining cylinder heads for the Wright 14-cylinder Cyclone Engine. It consists of individual unit way-type drilling, reaming, boring, and tapping machines, all synchronized to function as a single unit. If any unit fails to function properly signal lights on a central control board quickly locate the trouble.

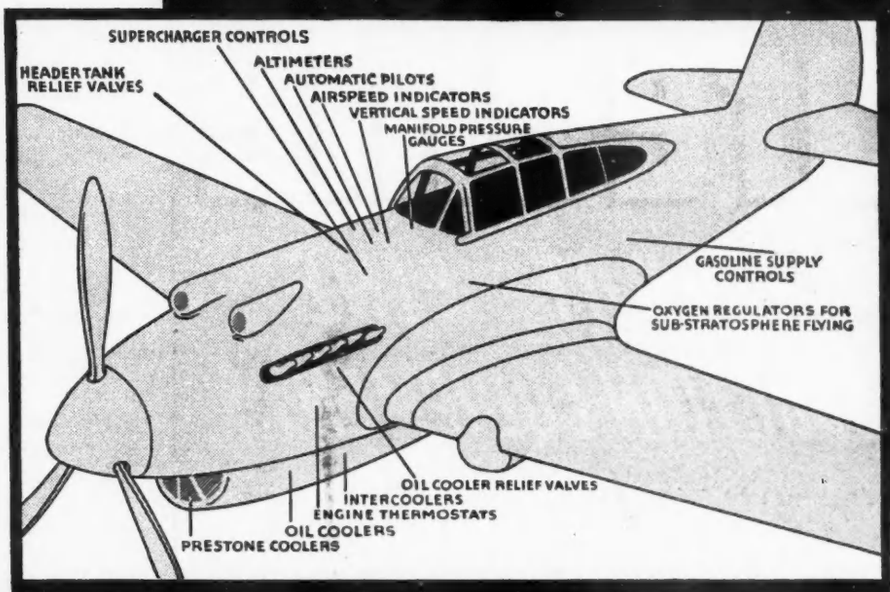
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Automatic Screw Machines
Aircraft Production Machinery





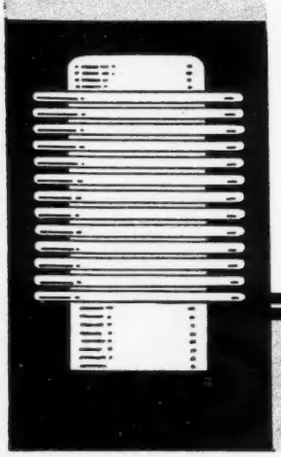
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METALLIC BELLOWS *and* EXTRUDED TUBING

...for Cooling, Cooling Control and Control Instruments.

HYDRON thin-wall hydraulically-formed metallic bellows are used in all types of temperature and pressure control devices for aircraft engine cooling systems, carburetors and superchargers.

HYDRON thin-wall extruded tubing is used in prestone radiators, oil coolers, inter-coolers, and after-coolers, for liquid-cooled and air-cooled motors.



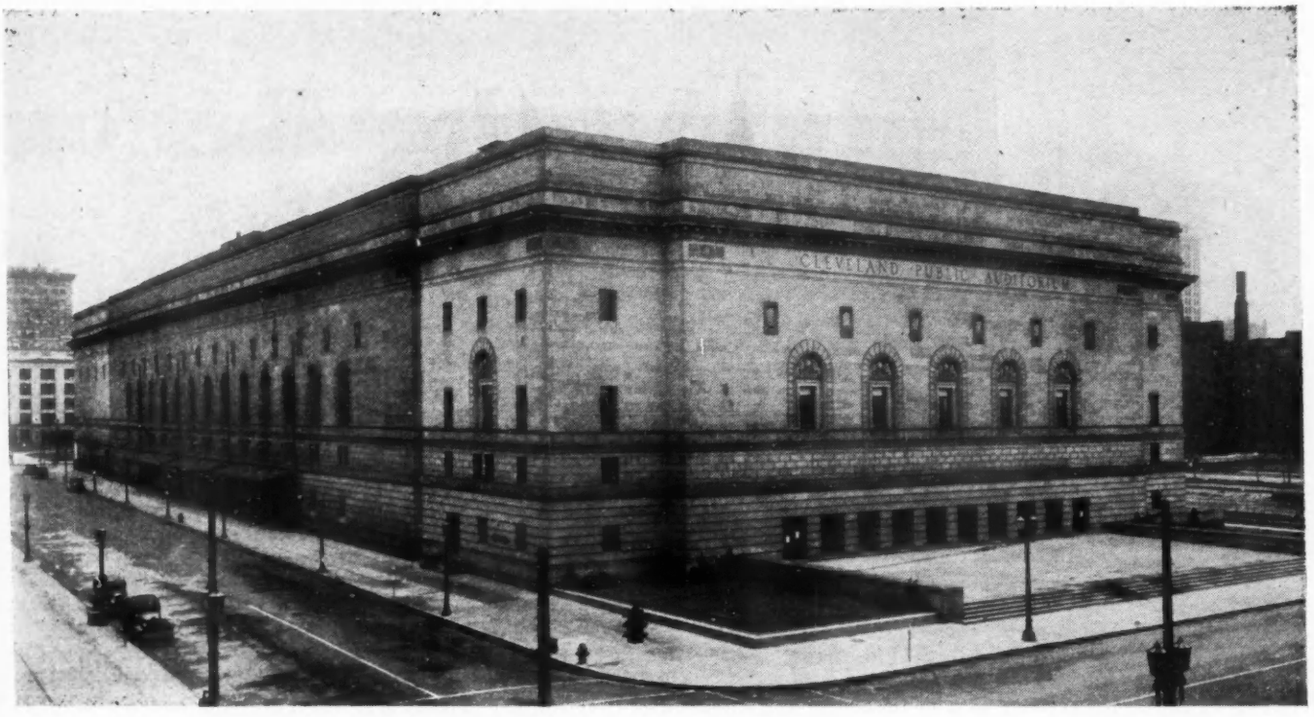
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CLIFFORD MANUFACTURING COMPANY

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Cleveland Public Auditorium

National Metal Congress



PLANS for the greatest mobilization of engineering, technical and production talent in the metal industry have been rounded into final shape for the National Metal Congress and War Production Edition of the National Metal Exposition to be held in Cleveland's Public Auditorium Oct. 12 through 16.

"This year's meeting will be far different from any held in the 24-year history of this big event," according to W. H. Eisenman, secretary of the American Society for Metals, and managing director of the exposition.

"The keynote this year will be education—education that will be devoted solely to increasing production of war products. All of the technical talent of the four co-operating societies, all of the engineering and production experts of more than 250 leading manufacturers, are being mobilized in this drive to help the metal industry do more with what it already has, to marshall every idea, every improved production method that will help win this war of metals."

Mr. Eisenman likened the meeting to a great university with some 200,000 sq. ft. devoted to class rooms, lecture halls, conference and display spaces, with a faculty of thousands of technical and production experts, men who are anxious and willing to discuss, counsel and advise as to how we can do more with what we have.

Among the many drawing cards to the meeting will be twenty-five ASM War Production Sessions patterned after the successful defense meetings at last year's Congress. Outstanding authorities in government and industry will speak briefly, informally and off-the-record on important phases of these 25 timely topics, with all speakers acting later as members of an Information Panel for open discussion.

These ASM War Production Sessions will be definitely practical, operating on a give-and-take basis with metal men getting answers to their problems and contributing to the solution of others. These sessions will be entirely in addition to the technical sessions of the four co-operating societies. They will be held every afternoon and the first three evenings of the week at the meeting rooms in Cleveland Public Auditorium.

The Auditorium will also be the scene of the War Production Edition of the National Metal Exposition, with more than 250 leading manufacturers contributing to the meeting's theme—an educational drive to help increase production of war products. These companies will have their leading technical and engineering experts manning educational and conference displays which will be located on the arena floor, the

(*Turn to page* 270, *please*)

As the Record





1939

Jan. 10—In a letter written to Rear Admiral Snyder, Pres. of the U. S. Naval War College at Newport, R. I., Admiral Harry E. Yarnall says, "*In the Far East, a situation has arisen which definitely threatens our national interests. The independence of China is in imminent danger due to the warlike actions of Japan . . . I cannot see how we can escape being forced into eventual war by the present trend of events.*" Copies of this letter were sent to the Chief of Naval Operations, the Commander in Chief of the U. S. Fleet, and to the Chairman of the General Board of the Navy.

June 7—Strategic War Materials Act, ordering War, Navy and Interior Secretaries to determine what these materials are; $100 millions appropriated to be spent during five fiscal years 1939-1943.

June 23—U. S. Government concludes agreement with England to exchange 600,000 bales of cotton for 90,000 tons of rubber.

Oct.—U. S. Army and Navy Munitions Board recommends study of synthetic rubber production and later holds conferences with rubber companies on the possibilities.

Dec. 31—American rubber stockpile decreases to total reserve of 90,000 tons, or about two months' supply in the form of industrial inventories, 1373 tons in the hands of Commodity Credit Corp. "pursuant to the Carter transaction," and 35,000 tons in the hands of dealers and importers, despite importation of 499,348 tons in 1939 (report of Truman Committee, May 26, 1942).

1940

JANUARY

1st—Tariff Commission pointing to decline of U. S. crude rubber stocks, issues report saying if shortage of rubber occurs this country undoubtedly can use much greater quantities of reclaimed rubber; production of substitutes could be expanded but probably from one to four years would be required before the industries could produce even the minimum requirements of the United States.

Jan. 26—United States trade treaty with Japan expires; trade relations continue on day to day basis.

Feb. 26—The War and Navy's Interdepartmental Committee on Strategic and Critical Materials, the agency concerned with the $100 millions strategic and critical material purchasing program advises the President that now is the time to buy. The President's suggestion to use $15 millions of the appropriation for the next fiscal year was pared down by the House Appropriations Committee to $12.5 millions, but of that amount only $5 millions was made immediately available by the Senate.

May 29-31—DUNKIRK.

June—U. S. Army and Navy Munitions Board recommends the acquirement of 416,000 tons of rubber.

Representatives of rubber companies testify before Senate Military Affairs Committee that synthetic plants can be built with government financial assistance.

National Defense Advisory Council appoints a rubber advisory committee composed of representatives of rubber companies with William L. Batt as deputy for Edward L. Stettinius, Industrial Materials Division, to supervise work of the committee.

June 10—ITALY DECLARES WAR ON FRANCE AND BRITAIN.

June 22—FRANCE FALLS.

June 25—Congress authorized R.F.C. to set up government corporation to acquire stocks of raw materials.

June 28—RFC forms Rubber Reserve Company, with loan of $140 million, which opens negotiations with British-Dutch for the acquirement of 150,000 tons of crude rubber by end of 1940.

July 14—P. W. Litchfield, President Goodyear Tire and Rubber Co., points out rubber is basic essential in all forms of transportation and communication; we obtain 96 per cent of our crude rubber from East Indies and vicinity, half way around the world; all major nations of the world save U. S. are

on Rubber Unfolds

at war, thus placing in potential jeopardy the established means of getting rubber into this country.

Aug. 7—NDAC rubber committee, after conferences with rubber companies, recommends that government proceed with construction of plants with a capacity of 100,000 tons of synthetic rubber.

Aug. 15—Agreement with International Rubber Regulations Committee provides for increasing rubber reserve stocks to 330,000 tons through additional purchases to be made during 1941.

Sept. 1—Rubber stocks represent 10.6 months' supply normally or nine months at emergency rates of consumption.—Truman Committee Report.

Sept. 12—E. L. Stettinius sends memorandum to President recommending that RFC funds be made available for construction of synthetic rubber plants with 100,000 tons annual capacity, estimating that it will take 18 months and $50 million to construct plants. No provision made for construction of plants for butadiene.

"IT is imperative to correct this deficiency (insufficient production of rubber in Western Hemisphere) if possible, so as not to be dependent entirely on foreign sources of supply. Our dependence on foreign rubber would place us in a critical condition if supplies were restricted or interrupted, as might be the case, in the event of war."

—U. S. Department of Agriculture Year Book for 1927.

Sept. 13—U. S. Army and Navy Munitions Board approves Stettinius proposal as a defense measure.

Sept. 22—FRENCH INDO-CHINA. Japan and France reach agreement giving Japan air bases and right to maintain troops in Indo-China.

Sept. 27—TRIPARTITE ACT. *Japan joins with Rome-Berlin Axis. U. S. Dept. of Commerce cites pact as a threat to America's rubber supply.*

Oct.—Jesse Jones given complete control of rubber program.

—Five rubber companies submit engineering plans for 100,000-ton synthetic plants.

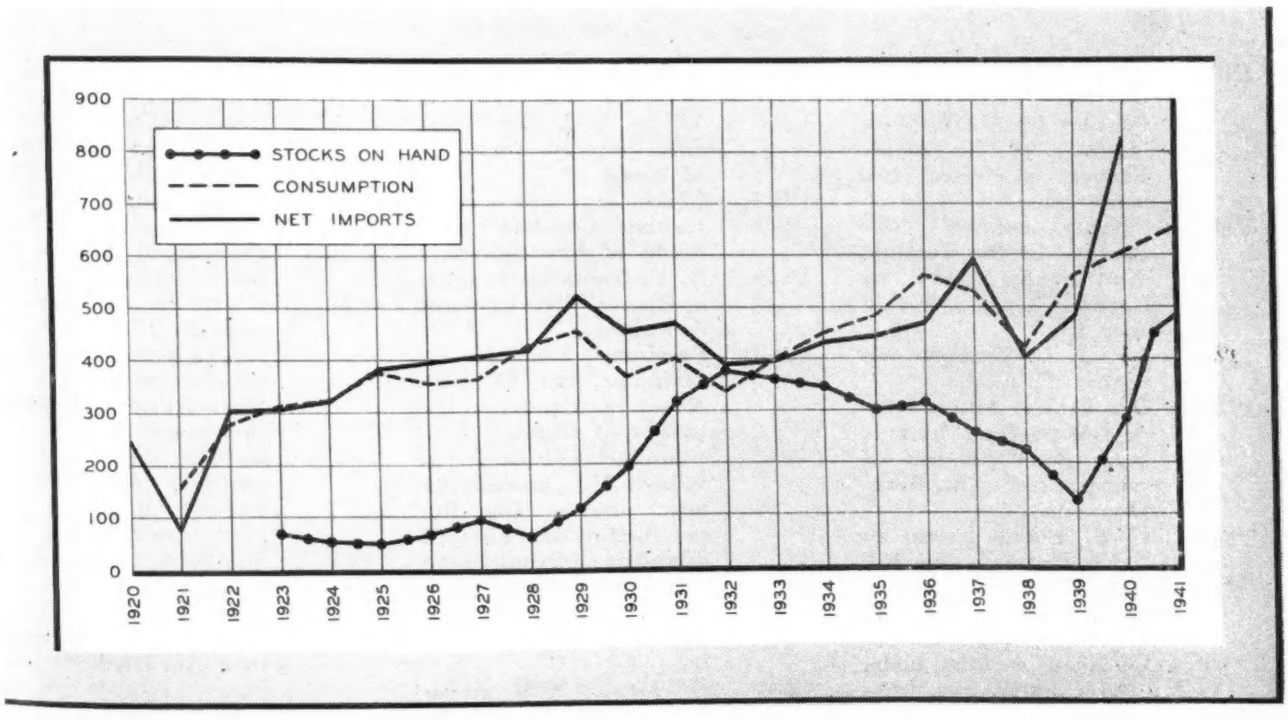
Oct. 4—*"If the United States refuses to understand the real intention of Japan, Germany and Italy, and persists in challenging those powers, in belief the pact is a hostile action, there will be no other course open than to go to war."*—Japan's Premier Konoye.

"I fling this challenge to America. If she in her contentment is going to stick blindly and stubbornly to the status quo in the Pacific, then we will fight America."—Japan's Foreign Minister Matsuoka.

Oct. 8—U. S. State Dept. advises American citizens to leave Far East.

Oct. 10—NDAC states it believes the 100,000-ton synthetic program is unnecessary since private industry

The Rubber Picture over the Years



Approximate Pneumatic Casing Production

1921	29,088,000	1931	48,744,000
1922	40,932,000	1932	40,080,000
1923	45,264,000	1933	45,300,000
1924	51,636,000	1934	47,232,000
1925	60,852,000	1935	49,356,000
1926	61,608,000	1936	56,040,000
1927	64,440,000	1937	53,310,000
1928	77,940,000	1938	40,184,000
1929	68,724,000	1939	57,613,000
1930	50,964,000	1940	59,186,000
		1941	61,532,000

Reclaimed Rubber Statistics

	Consumption	Production
1929	217,020	214,284
1930	153,456	160,128
1931	123,000	129,684
1932	77,504	75,765
1933	85,003	93,586
1934	100,855	107,765
1935	117,523	119,906
1936	141,486	150,571
1937	162,000	185,000
1938	120,800	122,400
1939	182,603	195,243
1940	187,977	190,304
1941	212,940 10 months	228,524 10 months

Stocks on Hands as of Dec. 31st of Each Year

Except for the Year 1941

Long Tons

1923	72,920	1933	365,000
1924	56,080	1934	355,000
1925	51,215	1935	303,000
1926	72,510	1936	223,000
1927	99,282	1937	262,200
1928	65,454	1938	231,500
1929	122,062	1939	138,020
1930	201,000	1940	288,864
1931	322,000	1941	454,711*
1932	379,000	1942	578,000†

* End of October figure.
† 6 Months (Baruch report.)

Source of these data — Statistical Abstract of the United States, 1941

contemplates construction of 30,000-ton capacity. Government, therefore, it holds, need built only 70,000-ton capacity.

Oct. 15—Stettinius renews his suggestion for 100,000 tons capacity.

Oct. 21—Stettinius' recommendations sent to Jesse Jones.

Nov. 5—OPM starts to dole out rubber while buying under private contract continues at peak.

Nov. 5—Jesse Jones agrees with British-Dutch to prevent flooding of rubber market. Cartel increases production.

Dec.—Government has received only 72,000 tons of rubber on cotton-rubber deal and 40,000 of the 150,000 tons allotted to rubber reserve company. (British-Dutch do not want to increase export quota, fear economic collapse if emergency does not develop.)

Dec. 5—Jesse Jones sends out proposals to rubber companies asking for suggestions on construction of synthetic plants.

1941

Jan.—Echoing the warnings of the rubber industry, John L. Collyer, president of The B. F. Goodrich

Some Synthetic Birthdays

1882 First laboratory production of synthetic rubber, by Sir William Tilden, in England. Process perfected two years later.

1914-18 "Methyl-rubber" (discovered by the Russian, Konbakoff) used by German Army in World War I.

1922 Dr. J. C. Patrick discovers Thiokol.

1925 Dr. E. K. Bolton's experiments lead him to later developments of Neoprene (formerly Duprene).

1934 U. S. grants patent to Erich Konrad and Edward Tschunkhur (assigned to I. G. of Germany) on Buna N. Eighteen months later, grants patents on Buna S. By agreement made in 1929 with Standard Oil of N. J., these patents become property of latter.

1937 Goodyear Tire and Rubber Co. tests tires made of Chemigum.

1940 B. F. Goodrich Co. announces development Ameripol.

1940 President Farish of Standard Oil of New Jersey announces discovery of Butyl.

1942 Standard Oil of N. J. (May 21) announces new process for the production of increased quantities of butadiene and improved quality of 100-octane aviation gasoline simultaneously.

1942 William O'Neill, president of the General Tire and Rubber Co., asserts that the future of America may lie in the Salinas Valley, Calif., where a large undertaking in the growing of guayule has been started.

1942 Eugene Houdry announces (July 9) to newspapers, new process for manufacturing butadiene, claiming faster and cheaper production and need for smaller quantities of critical material for plant construction.

1942 Standard Oil of N. J. announces (July 21) development of Flexon process for manufacture of synthetic rubber.

Rubber Statistics of the United States

	Imports	Reexports	Net Imports	Per Cent of World Production
	Long Tons			
1920	253,681	4,160	249,521	73.0
1921	185,452	5,716	179,736	59.6
1922	301,077	4,809	296,268	72.9
1923	309,145	8,772	300,373	73.5
1924	329,412	10,309	319,103	74.9
1925	400,423	14,827	385,596	73.0
1926	417,643	17,671	399,972	64.3
1927	431,246	27,775	403,471	66.5
1928	439,731	32,159	407,572	62.3
1929	565,087	36,485	528,602	61.2
1930	487,628	30,205	457,423	55.7
1931	501,788	25,609	476,179	59.5
1932	414,668	20,937	393,731	55.6
1933	418,902	20,576	398,326	46.7
1934	463,018	23,856	439,162	43.1
1935	467,146	11,390	455,756	52.2
1936	488,145	12,581	475,564	55.4
1937	600,476	7,948	592,528	52.0
1938	412,092	5,652	406,440	45.4
1939	499,616	13,125	486,491	48.4
1940	818,242	7,060	811,182	58.3
1941 First 9 months	763,987	.....	.....	....

Significant Portents

1931 MANCHURIA invaded by Japan.

1935 ETHIOPIA invaded by Italy.

1936 RHINELAND reoccupied by Germany.

1937 CHINA invaded by Japan.

1938

Mar. AUSTRIA annexed by Germany. Oct. 1 Germans enter Czechoslovakia.

1939

Sept. 1 Poland invaded by Germany. Sept. 3 Britain and France declare war on Germany.

Co., says "because of our dependence on the Far East for fully 98 per cent of our crude rubber, every step must be taken to insure that no crisis in that part of the world * * * may interfere with the carrying out of our National Defense program."

Feb. 3—One ton of selected Philippine rubber seed is rushed to Brazil in Army bombers.

Feb. 5—Intercontinental Rubber Co. reveals one unit is producing 10,000 pounds of guayule daily. "May be the answer to one of America's Defense problems if war spreads to the Pacific."

Feb. 20—Stettinius, Director of Priorities, OPM, announces priority committee for rubber.

Feb. 20—Jesse Jones says present crude rubber stocks are sufficient to last two years. RFC consideration of stand-by plants or loans to commercial firms to build plants was "general and to be used only in the event of an emergency."

Feb. 26—*The New York Times* in reviewing a Presidential press conference of Feb. 25 states. "The President expressed his belief that the United States was in no danger of running short of rubber * * * much raw rubber has been brought into the country and there is a good sized supply on hand. If a pick-up campaign becomes necessary, enough rubber could be obtained from old tires and used rubber to keep going until synthetic plants could be put up."

March 7—OPM places neoprene under priority rating.

(*Turn to page* 244, *please*)

Consumption of Crude Rubber in the United States

	Total Consumption	Per Cent Consumed for Tires and Tubes
1921	169,308	76
1922	283,272	71
1923	319,704	68
1924	328,764	82
1925	388,476	85
1926	366,156	82
1927	372,996	80
1928	437,004	83
1929	467,400	81
1930	375,996	78
1931	355,188	77
1932	336,744	73
1933	412,368	71
1934	462,480	69
1935	491,544	71
1936	575,000	71
1937	543,599	71
1938	437,031	66
1939	577,591	71
1940	618,349	71
1941	766,000*	

* Truman Committee Figure.

Average Price per Pound at New York of Smoked Sheets

1920	$ .359	1931	$ .062
1921	.165	1932	.035
1922	.173	1933	.060
1923	.307	1934	.129
1924	.264	1935	.124
1925	.730	1936	.165
1926	.487	1937	.194
1927	.381	1938	.147
1928	.226	1939	.179
1929	.206	1940	.202
1930	.119	1941	.224

Production Started On New Tank Destroyers

Auto Plants Continue to Boost Output, Cut Production Time; Diesel Engines, Versatile, Tough, Hold Limelight

Three new model tank destroyers are in the process of production or development, Robert P. Patterson, assistant secretary of war, revealed recently at the formal opening of the Tank Destroyer Training Center at Camp Hood, Tex. Deliveries of one improved model of the heavily armed vehicles already have started, according to Patterson.

Several automotive companies have been given orders for the fast TD's but production has been delayed while the Army standardized on a design embodying all the latest developments learned from tank warfare in the Libyan desert and elsewhere. These motorized vehicles travel on multiple wheels and are capable of speeds up to 70 mph. They are lightly armored but heavily armed, depending upon speed and maneuverability to outwit the enemy tanks. Some are powered by more than one engine. Their several guns of various calibres can fire forward while the vehicle is in motion. Thus they have an advantage over guns towed by trucks or tractors, which have to be unlimbered and turned around before they can fire.

Soviet troops have used weapons of the tank destroyer type to deadly advantage against Nazi tanks. These tank destroyers also proved valuable to U. S. troops in their delaying action against the Japanese on the Bataan peninsula. The new models are receiving thorough tests over the 108,000 acres of Texas landscape at Camp Hood.

Diesel engines are receiving much emphasis in this war, both to propel naval craft, such as submarines, mine sweepers, landing boats, and harbor tugs, and to drive tanks, tractors, and earth movers. Detroit Diesel Engine Division of General Motors is turning out these Diesel power plants on a mass production basis, especially the 71 Series two-cycle engine. In this engine the cylinder liners, fuel pump assembly, exhaust valve assembly, piston and connecting rod assembly, injector, rocker arms, rocker shaft and bracket assembly, and many other parts are exactly the same in every engine in the entire range of models. This is important in simplifying maintenance and repair because various size engines use the same spare parts, whether they are utilized in boats, tanks or stationary installations. The adaptability of this type engine to numerous types of power take-off and to a wide variety of accessory arrangements and any type of load, whether continuous or intermittent in speed or power, allows a wide variety of applications.

In the new twin Diesel used for tank installation, two basic engines are coupled together by a simple gear and clutch arrangement to a single power take-off shaft. The engine design which permits placing the accessories on either side of the engine and rotation in either direction makes this possible.

One of the biggest suppliers of Diesel engine parts under the expanded production program is the Pontiac Motor Division of G.M. To achieve a 100 per cent increase in diesel parts output, Pontiac engineers rebuilt 300 automotive machines. Rebuilding time on the various machines varied between 400 and 1000 man-hours each, but the retooling saved 50 to 75 per cent of the cost of the new machines, which would not have been immediately available, anyway, due to the huge demands upon the machine tool industry.

Diesel engines can burn not only the regulation petroleum fuel oil but other types of fuel as well. Rudolph Diesel operated one of his first engines on gasoline and others on coal dust. Laboratory experiments have been made in which Diesel engines were run successfully on coal oil, tung and soy bean oil, 80-octane and 100-octane gasoline. The advantages of a power plant which can burn several kinds of fuel with only minor adjustments in the engine can be readily seen in war-time with the complicated problems of supply and communication, especially in a global war.

When Donald M. Nelson told the House Committee on Defense Migration recently that "we are on the big upswing in production," he could have cited the experience of the Chrysler Corp. in the manufacture of Bofors 40-mm anti-aircraft cannon. Production of these weapons last February was substantially in two figures. By April this output had increased 10-fold and in July it was 30 times that of February. Whereas the production of these Swedish-designed guns abroad had required about 450 hr. assembly time, Chrysler experts reduced the assembly time to less than 14 hr. Each of these Bofors guns comprises 5472 individual parts. One hundred-pound breech rings are manufactured from 315-lb. steel forgings. The rough cast or forged barrels, weighing 400 to 570 lb., have to be machined, bored, rifled, and finished.

Chrysler has dispersed the gun manufacturing operations among 11 of its plants. Castings come from one plant, breech rings from another, recoil mechanisms from a third, barrels from a fourth, and loading mechanisms from a fifth plant. DeSoto has been assigned a major gun section requiring 54,800 sq ft of plant space. Dodge is devoting 84,610 sq ft to gun manufacture, Plymouth is employing 116,224 sq ft, Highland Park has assigned 213,110 sq ft

(*Turn to page* 178, *please*)



Acme

Dedicate Tank Destroyer Center

The Army has taken over Camp Hood, Texas, for the training of tank destroyer crews. Here, at dedication ceremonies, destroyers are lined up for inspection.

"STANDARD EQUIPMENT" IN PEACE IS ONE THING



BUT TODAY, almost before a test pilot can take a new fighter plane "upstairs," its design is changed. Faster engines are constantly being demanded — and delivered . . . tougher fabricating materials developed.

Yet the warplane whose wings are still blueprint paper has one thing in common with aircraft designs that have gone before — the Torrington Needle Bearing.

Changed-over to production-for-war, the Needle Bearing is once more proving its adaptability, in applications where its unique advantages mean more than ever. Low coefficient of friction, for example, makes it especially well-suited to manual control operations in fighter planes, assuring smooth, steady performance.

Not only in aircraft production but throughout industry, every feature of the Needle Bearing is filling some vital wartime need. Its small size is saving space and critical materials . . . its remarkable ease of installation cutting assembly time, its design eliminating extra parts and assembly steps, its high capacity and efficient lubrication reducing the need for replacement or maintenance attention in service.

Small wonder that the Torrington Needle Bearing has become standard equipment, too, in America's production-for-Victory program.

***FOR INFORMATION** concerning capacities and sizes, send for Catalog No. 107. Or consult a Torrington engineer. He is well qualified in adapting the Needle Bearing's unique advantages to specific problems.*

THE TORRINGTON COMPANY
TORRINGTON, CONN., U. S. A. • *Est. 1866*
Makers of Needle and Ball Bearings
New York Boston Philadelphia Detroit
Cleveland Seattle Chicago Los Angeles
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TORRINGTON NEEDLE BEARING

Every feature fills a wartime need



Acme

Seek to Solve U. S. Rubber Shortage

Donald Nelson (left), Chairman of the War Production Board, and William M. Jeffers, newly appointed Rubber Administrator, are pictured as they met in Washington on September 16 to start work on solving the acute rubber shortage.

Wage Boost Granted GM Workers

WLB Orders Other Changes in Contract with CIO Units; Union Leaders Dispute Presidential Wage Premium Ban

General Motors employes have been awarded a wage increase of 4 cents per hour under the terms of a decision handed down Sept. 17 by the War Labor Board. In granting the raise to 225,000 GM hourly rated workers, members of the UAW-CIO and the United Electrical, Radio & Machine Workers (CIO), the full board rejected several recommendations made Aug. 14 by the three-man mediation panel, among them a 5-cent per hour raise. The 4-cent raise will be retroactive to April 28 and will cost GM approximately $25 million annually on the basis of present payrolls. The union had asked a 12½-cent per hour raise.

The WLB rejected by a 6-3 vote the panel recommendation of a 3½-cent-per-hour raise to narrow the 6.7-cent-per-hour differential which the union claimed existed between GM and Ford wages. Then instead of falling back on the 1½-cent-per-hour raise which the panel said was justified to adjust GM wage rates to the 15 per cent rise in the cost of living between Jan. 1, 1941, and May, 1942, the WLB said the employes were entitled to a flat 4-cent-per-hour raise.

A maintenance of membership clause was ordered by the WLB under which employes have 15 days in which to resign from the union if they do not want to be bound to remain a member for the duration. The panel plea that this clause be retroactive to last Jan. 1, thus "freezing" all present members in the union, was denied. The order directed that men and women employees be given equal pay for equal work. A proposal to raise the night shift premium from 5 to 10 per cent was rejected, 5-4, by the board.

The WLB granted two weeks' vacation pay for all employees with five years or more seniority instead of to those with two years' seniority, as recommended by the panel. Those with one year or more seniority will receive one week's pay. The powers of the umpire under the contract were extended, empowering him to settle disputes in virtually all fields except wages. Members of the board participating in the decision were W. H. Davis, chairman; F. H. Graham and F. L. Morse, representing the public; H. L. Derby, R. F. Black, and A. E. Roth, representing employers; Thomas Kennedy, Richard Frankensteen, and Fred Hewitt, representing labor.

Only official comment on the decision from labor was made by August Schoble, president of the Michigan CIO, who said, "The decision completely and miserably fails to meet the justifiable demands of the CIO. Those demands were made primarily on the increased cost of living and secondarily on the profit showing of the corporation for the past year."

Dispute over the issue of premium pay for Saturday and Sunday work when it comes within the 40-hour week was settled by executive decree when President Roosevelt issued an order abolishing such extra compensation on all work relating to the prosecution of

(*Turn to page* 178, *please*)

MEN . . . . . .

William A. Blees, formerly general sales manager of the Nash Division of Nash-Kelvinator Corp., has joined Young & Rubicam, Inc., in an executive capacity.

William B. Stout, president of Stout Engineering Laboratories, Inc., has been appointed to the special board of consultants of the Smaller War Plants Corp.

Philip C. Handerson has resigned as sales promotion and advertising manager of Harry Ferguson, Inc., Dearborn, distributor of Ford tractors, to become director of the USO Club at Grosse Ile, Mich.

Maj.-Gen. Walter C. Short, commander of the Hawaiian Dept. of the U. S. Army until his recent retirement, has been named head of the traffic dept. of the Ford Motor Co. branch at Dallas, Tex.

Edward V. Rippingille, assistant general manager of the General Motors Corp. research laboratories, has been appointed to the Detroit Board of Water Commissioners.

Alan P. Beebe, vice president of the Peninsular Grinding Wheel Co., and **Steven J. Menzel,** president of the Motors Metal Mfg. Co., have been elected directors of the Tuff-Hard Corp., Detroit manufacturer of tool bits and special tools. **F. A. Endress** has resigned as president to devote his time to research and development work. **John Z. Lander,** formerly vice president, has been named executive vice president.

Reginald Everett Gillmor, president of Sperry Gyroscope Co., has been elected chairman of the executive committee of Fairchild Engine and Airplane Corp.

William T. Hedlund has been appointed president Elastic Stop Nut Corp., Union, N. J. He was formerly vice-president of Electrolux Corp., in charge of engineering.

The Board of Directors of the Titeflex Metal Hose Co., have elected **Elbert E. Husted** president of the company. He has

(*Turn to page* 178, *please*)

CALENDAR

Conventions and Meetings

SAE War Transportation and Maintenance Mtg., New York City. Oct. 7-8

Natl. Metal Congress & Exposition, Cleveland ..... Oct. 12-16

American Welding Society, Detroit, Annual Mtg. ..... Oct. 12

American Society of Tool Engineers, War Production Conference, Springfield, Mass. ..... Oct. 16-17

Automotive Advertisers Council, Chicago ..... Oct. 19-21

SAE National Fuels & Lubricants Mtg., Tulsa ..... Oct. 22-23

Assoc. of American Battery Manufacturers Annual Convention, Chicago, Oct. 22-23

Natl. Lubricating Grease Inst., New Orleans, Annual Mtg. ..... Oct. 25-28

Natl. Safety Congress and Exposition, Chicago ..... Oct. 27-29

Natl. Safety Council, Chicago, Annual Mtg. ..... Oct. 27-29

Natl. Industrial Chemical Conf. & Exposition, Chicago ..... Nov. 17-22

American Petroleum Inst., Annual Mtg., Chicago ..... Nov. 9-13

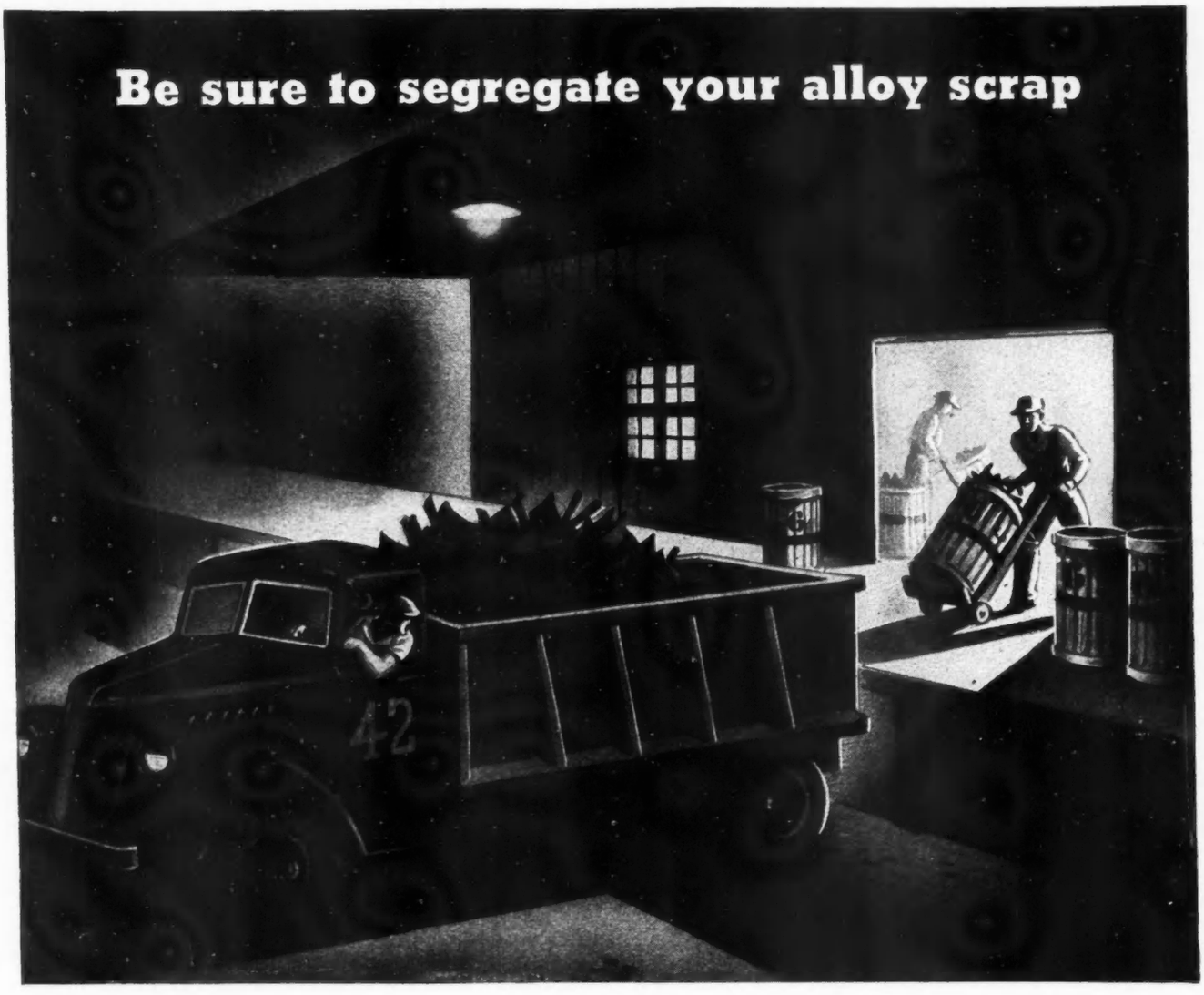
Amer. Society of Mechanical Engrs., New York City, Annual Mtg. Nov. 30-Dec. 4

Highway Research Board, St. Louis, Mo. ..... Dec. 2-4

SAE Air-Cargo Engineering Mtg., Chicago ..... Dec. 8-9

SAE War Production-Engineering Mtg., Detroit ..... Jan. 11-15

Be sure to segregate your alloy scrap



Careful segregation and identification of alloy iron and steel scrap should be standard procedure in every plant collection program.

1. It helps conserve essential, scarce alloying elements.
2. It helps eliminate wasted time, material and effort in the steel mills.

Alloying elements such as cobalt, molybdenum, nickel and tungsten are readily recoverable from scrap. If their presence in a lot is known, the scrap can be used in making up a charge of alloy steel of the same or similar analysis. The amount of alloying elements that must be taken from stock is reduced.

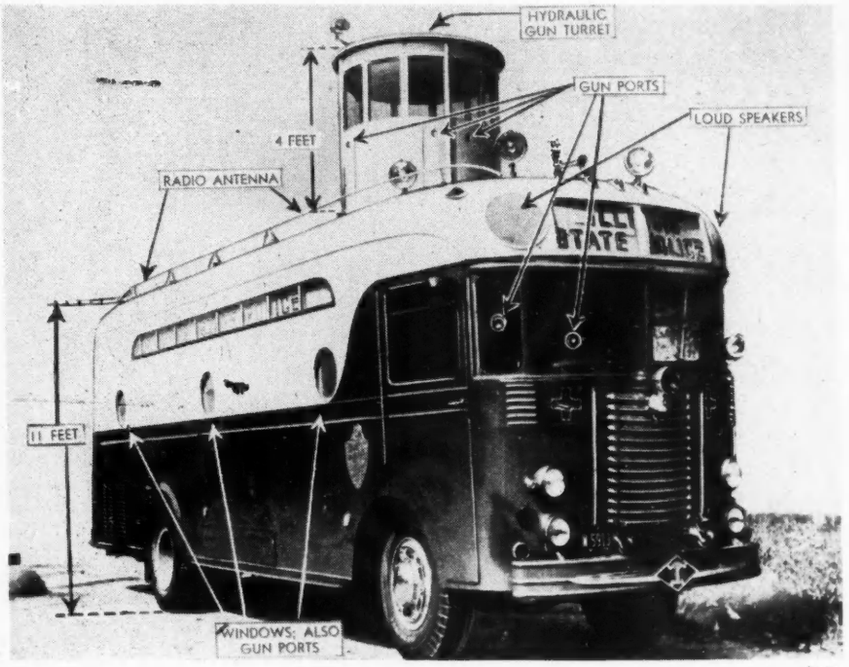
But, if, through lack of segregation, alloy scrap gets into a charge where no alloys are wanted, such as a plain carbon steel, the alloying elements are utterly wasted. It is also possible that the heat itself will be lost because of failure to meet specifications.

The difficulties of scrap segregation increase with every handling. The source is the best point for segregation. Comparatively little time and trouble taken there will save a great deal of trouble and wasted time at the mill.

CLIMAX FURNISHES AUTHORITATIVE ENGINEERING DATA ON MOLYBDENUM APPLICATIONS.
MOLYBDIC OXIDE—BRIQUETTED OR CANNED • FERROMOLYBDENUM • "CALCIUM MOLYBDATE"

Climax Mo-ly-b-den-um Company
500 Fifth Avenue • New York City

MOLY



Acme

Crime Lab on Wheels

This mobile 16-ton armored crime detection laboratory has just been put into service by the Illinois State Police. Featuring an hydraulic gun turret, the new machine carries hospital supplies, photographic equipment, fire-fighting apparatus, and water-rescue equipment, including a collapsible rubber boat.

British Aircraft Group Inspects U. S. Plants

Greater exchange of production and engineering information between U. S. and British aircraft manufacturers was foreseen as the result of the recent visit of the British Ministry of Aircraft Production Mission to Detroit. At a luncheon attended by the dozen members of the British mission and leaders of the automotive industry, Alex Dunbar, comptroller general of the British Ministry, said, "We feel that there's a lot for us to learn. We've come over here with open hearts and open minds to learn what we can."

Dunbar said the four great problems of British aircraft production are materials, machine tools, manpower, and dispersal. Bombings by the Luftwaffe cause the dispersal problem, which so far is not a factor in U. S. production. All British assembly lines are run in duplicate or triplicate at scattered points so a single bombing will not knock out all production of one type plane or engine.

George Romney, general manager of the Automotive Council for War Production, promised the utmost cooperation by U. S. aircraft manufacturers formerly in the automotive industry.

During the Detroit visit the British mission inspected the Packard Rolls-Royce aircraft engine plant, where the Merlin XX engine is being made for British Spitfire fighters and Lancaster bombers. The Britons also went through the huge Ford Willow Run bomber plant. From Detroit the British party went to Kansas City and thence to the Pacific Coast to inspect aircraft plants there.

William Samuels

William Samuels, 57, project engineer with the Chevrolet Motor Division of General Motors, died recently at his home in Detroit. He was the author of "Engine Bearing Loading."

PUBLICATIONS

A new 8-page booklet, describing **a-c welders** designed especially for use with the Unionmelt welding process to speed industrial production, is announced by the Westinghouse Electric and Mfg. Co. Several applications are listed and described and photographs illustrate the various parts of the unit and some applications.*

A 4-page folder citing advantages of **uniformity of hardness and grain structure in honing** and super-fifinishing stones was issued recently by the Mid-West Abrasive Co. It is a revised edition of a similar folder published several years ago. The back cover contains a chart to be used as a guide for the selection of the proper stones intended for use on steel of known hardness.*

Mid-West Abrasive Co. has also issued a booklet, **Grinding Wheels—Their Construction and Selection,** which contains photographs of various types of its wheels, honing and superfinishing stones. It presents a comprehensive picture of how grinding wheels and other solid abrasives are made and what they are made of, as well as a number of interesting tables and charts detailing grain and grade specifications, recommended grinding wheel speeds, minimum spindle, diameters, etc.*

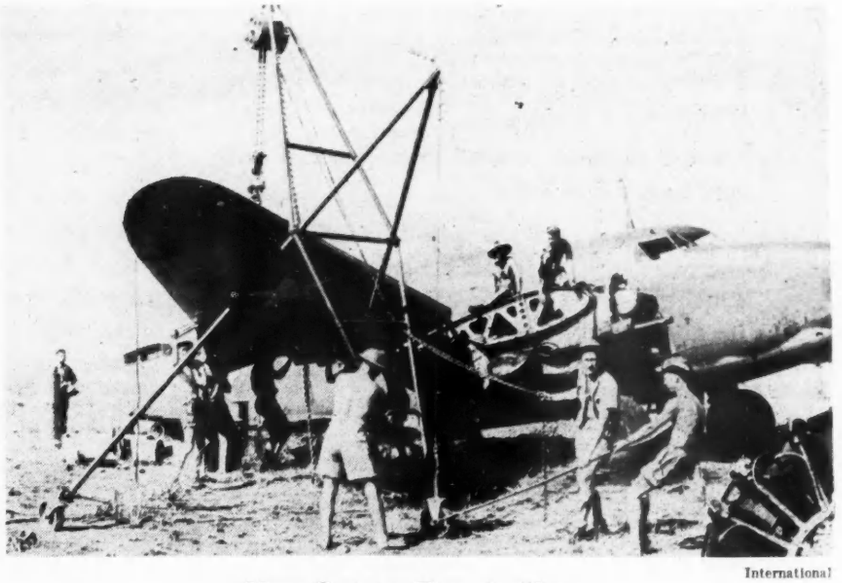
Chicago Wheel & Mfg. Co. has issued a new booklet on the use of **mounted wheels and accessories for portable tools.** It gives information required for fitting mounted wheels to the job, has a selection guide on the use of mounted wheels includes descriptions and illustrations of a wide variety of portable tool accessories.*

A new bulletin illustrating and describing Drilvise, a new product of Studebaker Machine Co., has just been issued.*

A 16-page illustrated bulletin issued by the General Electric Co. described in detail the progressive steps in the adjustment and operation of the **Atomic-hydrogen Electrode Holder.** The bulletin is carefully organized throughout for quick reference.*

A revised edition of Allegheny Ludlum Steel Corp.'s **Handbook of Special Steels,** which incorporates all pertinent information on the various grades of stainless, tool and other special alloy steels, has

(*Turn to page* 178, *please*)



International

New Guinea Repair Shop

In this far-off island, where the power of a single plane may mean the difference between victory and defeat, wrecked planes are salvaged for spare parts. Here an Australian repair crew is removing a wing from a damaged U. S. plane.



IT SPREADS ON THE THREADS... *and stays there!*

PERMATEX PIPE JOINT CEMENT

Ready for use. Flows easily from the brush, spreads evenly over the threads . . . and then holds its position.

Does not dry hard or crack. Permits easy readjustment. Disassembles readily. Prevents thread seizure.

Permatex Pipe Joint Cement seals completely against hot and cold water, steam, salt water, illuminating gas, lubricating oils, fuel oils, gasoline, gasoline vapor, kerosene, ethylene glycol, glycerine and numerous other liquids and gases.

Extensively used on threaded connections and flange surfaces of pipe lines, pumps, tanks and similar equipment wherever pressure-tight, leak-proof unions are required.

PERMATEX COMPANY, INC., Sheepshead Bay, N. Y., U. S. A.



Tank Destroyers

(*Continued on page* 172)

to the gun job, and Chrysler-Jefferson is using 194,057 sq ft.

The Ford Willow Run bomber plant was another productive center that Nelson may have had in mind when he asserted that the big flow in armaments is just ahead. At recent ceremonies marking the dedication of new highway facilities at Willow Run, Edsel Ford, president of Ford Motor Co., said, "This bomber job is new to all of us. Practically every person you see before you had to be newly trained to the important work he or she is doing . . . Unfortunately, premature publicity has led the public to expect too much ahead of time. Willow Run is operating on schedule, and in the matter of production we fully expect to exceed schedule."

Another Ford war project, the new magnesium plant at River Rouge, entered production in recent weeks, according to A. H. Bunker, chief of the WPB aluminum and magnesium branch. This plant is supplying magnesium castings for airframe and aircraft engine parts. The Ford magnesium foundry uses the ferro-silicon process developed within the past year. It is one of five new magnesium plants to enter production recently. Among the others is the Dow Chemical Co. plant at Velasco, Tex., which uses the standard electrolytic process.

Buick Motor Division of GM is shipping Pratt & Whitney aircraft engines ahead of schedule because it has used productive ingenuity to overcome obstacles that threatened to delay shipments. When the new Melrose Park, Ill., plant ran out of seamless tubing, welded tubes of the type used in automotive manufacture were substituted, with Air Corps approval, and a shutdown was averted. Use of standard packing cases for shipping the 1200-hp radial engines permitted only eight to be shipped in a single box car. Through redesign of the cases, it was possible to ship 18 engines per car instead of eight, thus effecting a great saving in vitally needed rail transportation facilities. Other delays have been averted by flying needed supplies to the plant so that the engine lines could continue operating.

Wage Boost

(*Continued from page* 174)

the war. The order, which becomes effective Oct. 1, saved the UAW-CIO from a dilemma. At the UAW convention at Chicago in August, the delegates had gone on record as asking for a return to premium pay rates for weekend work, which had been purportedly relinquished at a special meeting at Detroit last April, if other unions did not also waive this premium pay by Sept. 8. Other unions, especially in the AFL ranks, had shown no disposition to relinquish their weekend premiums, nor had the Ford, Chrysler, and Hudson locals of the UAW-CIO, covering one-third of the union's membership, waived this extra pay.

Matthew Smith, president of the Mechanics Educational Society of America, an independent union claiming to represent 42,000 workers, sent a telegram of protest to the White House saying, "This is just a plain cut in wages and moreover it is the unkindest cut of all." He blamed the UAW for this "mass cut in wages for all labor in America" and termed the order "disgusting." Frank X. Martel, president of the Detroit AFL, also opposed the premium pay ban, asserting that contracts are private matters between unions and employers. J. J. Griffin, of the Society of Tool and Die Craftsmen, an independent union with 12,000 members, said most tool and die shops already are on a seven-day basis, so the order probably would have no immediate effect.

MEN

(*Continued from page* 174)

been vice-president and general manager since 1938. Mr. Husted succeeds C. W. Fletcher, who died last July.

A. G. York, formerly assistant to the president and managing director of the Forged Steel Fittings Div. of the Watson-Stillman Co., was appointed this week vice-president in charge of sales for the entire company. He fills the vacancy created recently by the resignation of **J. C. Grindley** as sales manager of the Hydraulic Machinery Division. Other announcements by the board of directors include **R. W. Dinzl,** vice-president in charge of engineering; **F. H. Stillman,** assistant to the president and assistant secretary; and **William Woidt,** assistant secretary.

P. D. Block, Jr., was elected to the Board of Directors of the Inland Steel Co., succeeding his father, the late P. D. Block.

L. H. Chenoweth, manager of manufacturers' sales, The B. F. Goodrich Co., has resumed his duties after serving with the WPB in Washington.

E. C. Chatfield has been appointed sales manager of Transmotive Laboratories. He was formerly with the Pedrick piston ring organization.

Irwin A. Marshall has been appointed to the contact engineering staff of Foote Bros. Gear and Machine Corp., to represent the company in the Cleveland and Northern Ohio territory.

W. G. McFadden has been appointed acting manager of Allegheny Ludlum's Chicago office, replacing **R. E. Floyd,** now serving with the Government.

Reginald E. Gillmor, president of the Sperry Gyroscope Co., has been elected a member of the executive committee of Fairchild Engine & Airplane Corp.

Col. Clarence E. Jones, formerly executive officer at the Fort Wayne Ordnance Motor Supply Depot, Detroit, has been named commanding officer of the new Lordstown Ordnance Depot near Warren, Ohio. The Lordstown Depot will supply motor transport tools and equipment for Army camps and bases in the eastern U. S. and for task forces abroad.

Members named to the exhaust, cooling and lubricating systems sub-committee of the Automotive Replacement Parts Advisory Committee of WPB are **Fred Bahr,** vice president and general manager of the Chrysler Corp. parts division; **W. T. Walker,** chairman of the Walker Mfg. Co., Racine, Wis., and **Martin Malia,** G. & O. Mfg. Co., New Haven, Conn.

A. G. Neubauer, formerly head of the jobbing division of McAleer Mfg. Co., has been named manager of the jobbing division of Mid-West Abrasive Co.

Paul B. Hoffman, formerly sales and advertising manager of American Brake-Blok Division of American Brake Shoe & Foundry Co., has been commissioned a lieutenant (jg) in the U. S. Naval Reserve and will report for active duty Oct. 1.

Col. Arthur W. Herrington, board chairman of the Marmon-Herrington Co., has been elected a director of the Aviation Corp. He fills the vacancy on the board created by the resignation of Thomas M. Girdler.

A. W. Zimmer, formerly with the Allison Division of General Motors, has rejoined Reo Motors, Inc., as works manager. He was factory manager of Reo before he went to Allison in 1940.

Byron C. Foy, vice president of Chrysler Corp., has been elected a director of Dome Mines, Ltd.

Publications

(*Continued from page* 176)

just been issued by the company. It is particularly adapted for use by design engineers and production men, includes complete data for guidance in the proper selection, treatment, and use of these alloy steels, with finder charts and plenty of tables to facilitate quick reference.*

United Chromium, Inc., has issued a 6-page leaflet describing its **Unichrome Alkaline Copper Plating Process.** The leaflet also announces the new **Unichrome Alkaline Stripping Bath,** a process used in removing copper coatings from steel.*

A technical bulletin written by A. F. Curran, research and development chemist of the Curran Corp., describes the three fundamental steps necessary in **airplane engine cleaning and paint stripping** at major overhaul time. This labor-saving and time-saving process will be helpful to our war industries. The process is applicable for full operating and efficient production lines.*

The current issue of Monsanto Magazine, published by Monsanto Chemical Co., contains an article on **Saiflex,** a rubber substitute.*

The Norton Co. has issued a new booklet, **How to Increase Tool Life.***

American Foundry Equipment Co. has just issued a new illustrated manual on the care and operation of **Wheelabrator** airless abrasive blast cleaning equipment.*

South Bend Lathe Works has issued a new booklet, **How to keep your lathes clean,** which is the first of a new series of bulletins. It shows how keeping lathes clean will help increase production, reduce scrap, and lengthen the life of lathes. Bulletin 1004, a 4-page folder, describes and illustrates a **new Bench Model South Bend Turret Lathe** and its construction features.*

A booklet recently issued by Army Ordnance discusses the **"tremendous trifles"** which enter into the planning of increased production of war equipment.

The Douglas Fir Plywood Assoc. has published a handbook of **plywood** technical data for engineers and architects. Included among other data is general information about grades, physical properties and handling of fir plywood.*

*Obtainable through Editorial Dept., Automotive and Aviation Industries, Chestnut and 56th Sts., Philadelphia. In requesting any of these publications, please give date of issue, your company connection, and position.



those jeep riders have an ear cocked for radio instructions

ADVANCE TO COMBAT! DEPLOY! Lives hang in the balance when those short wave commands leap into sound. Of all times, that's the moment for *clear* radio reception — *not* for the muffled gibberish caused by Man Made Static!

Yet normally, the amount of electrical interference set up in a jeep car could drown out the clearest short wave signal—both in the jeep and the whole combat fleet of nearby vehicles. The generator causes some noise. High tension ignition adds more. It makes a perfect picture of a jeep fighting against *itself!*

Tobe Started To Solve The Problem Of "Man Made Static" 15 Years Ago

Fortunately, when it became necessary to build fighting vehicles and vessels *free* of radio interference, our long experience was ready for Uncle Sam. Tobe Filterettes now are found on thousands of Jeeps, Command Cars, Weapons Carriers and Tanks. The list of famous manufacturers who rely on Tobe equipment reads like a "Who's Who" in American business.

An Eye To The Future

At present, the needs of our armed forces head the list! But someday Tobe Filterettes and Capacitors will again be protecting *your* radio reception too—at home, in your car, aboard your boat—on both long and short waves. To radio interference caused by virtually any electrical device, you can say, *"No Noise Please! Thanks to Tobe Filterettes!"*

Illustrating the Willys Jeep which uses the Tobe noise suppression system developed in collaboration with U. S. Signal Corps Labs., Ft. Monmouth, N. J.

The heart of the Tobe Filterette is a dependable capacitor, designed and constructed with all the skill gained by 15 years of capacitor manufacture.



TOBE DEUTSCHMANN CORP.
TOBE
CANTON · MASSACHUSETTS

New Production Equipment

(*Continued from page* 93)

counterweight which balances the hand-slide and the multiple head. The unit illustrated is equipped for milling 20 bosses, using a five-spindle head, and the spindle indexes four times to complete the work. The Geneva indexing mechanism is used and is hydraulically operated. The index table serves as a chip trough and coolant retainer.

This machine is available with or without special tooling and speed-change gear for single- or multiple-spindle adaptations. The machine is available also in another size, 20 V 16, which has a capacity of 25 hp for driving tools, a 16-in. stroke, and a maximum hydraulic pressure on the slide of 19,000 lb.

THE Toolmaker grinder, a new type surface grinder just announced by the Delta Mfg. Co., Milwaukee, Wis., has a unique wheel-mounting arrangement that utilizes a two-piece adapter, so that either wheel, or wheel and adapter, can be removed. The advantage of this is that once a wheel has been trued up, it can be removed and replaced with the adapter and without any further dressing.

The spindle is extra long and is carried in widely-spaced bearings. The forward bearing is of the taper bronze type, with continuous oil-bath lubrication, while the rear bearing is sealed for life and requires no lubrication. The front bearing is provided with a take-up by means of which all play can be eliminated. The table has long ways and never overhangs the ends of the machine.



Delta Toolmaker grinder fitted with wheel mounting arrangement which permits the replacement of a trued-up wheel without further dressing.

The principal specifications of this grinder are as follows:

Max. length that can be ground, 13½ in.

Max. width that can be ground, 6 in.

Max. space under 7-in. wheel to table, 9½ in.

Table surface, 5¾ by 13 in.

Graduation of traverse feed, 0.001 in.

Max. wheel adjustment by micrometer, ⅜ in.

Graduation of micrometer wheel adjustment, 0.0005 in.

Min. diameter of cup wheel with guard in place, 3½ in.

Max. diameter of wheel, 7 in.

A HORIZONTAL boring mill of advanced design has been announced by The Yoder Company, Cleveland, Ohio. "Easy operation" is the keynote

INDIUM'S

Bearing on



Defense

Our long years of pioneering research with INDIUM to develop this miracle metal for the needs of Industry are now rewarded. Today, engineers are enthusiastic about the performance of INDIUM treated bearings and surfaces because only a small percentage of INDIUM greatly strengthens non-ferrous alloys and is the best defense against wear and corrosion. On land, on sea, and in the air, INDIUM proudly contributes to the speed-up efficiency of the Nation's program of **Defense.**

THE · INDIUM · CORPORATION · OF · AMERICA · Pioneers In element 49

This trademark assures optimum quality, pure INDIUM of standard effectiveness.

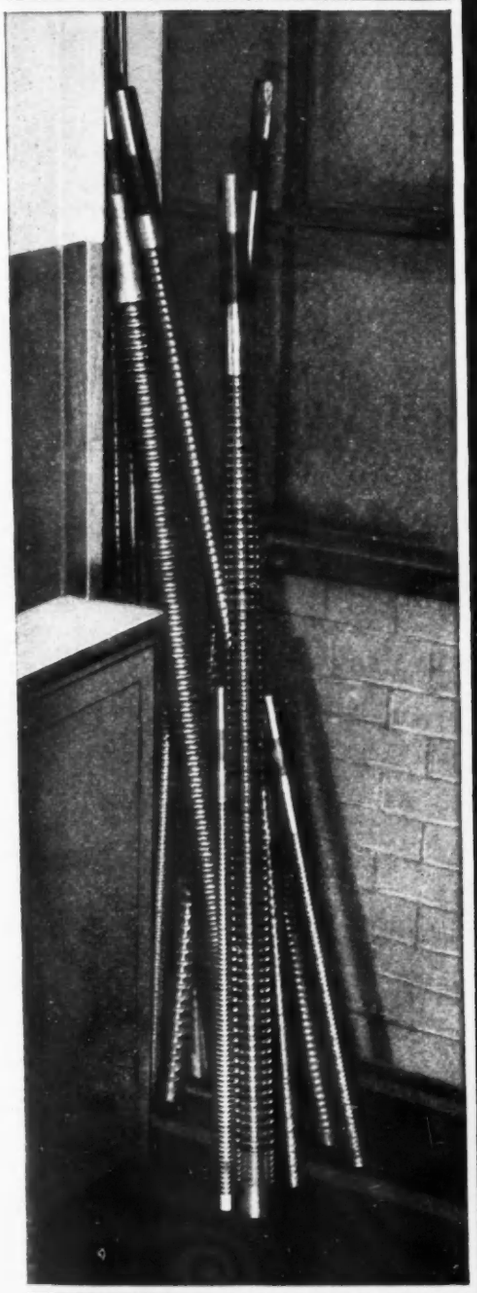
Informative literature on request.

THE INDIUM CORPORATION OF AMERICA

Research and Development Office
60 East 42nd Street, N. Y. C.

Sales Office and Laboratory
805 Watson Place, Utica, N. Y.

THE QUICKEST WAY TO SPOIL GOOD BROACHES . . .



. . . Lean them against each other in a corner

How to get more production with your Broaches------

1. BY PROPER HANDLING

IT TAKES time to recondition a damaged broach. Careless handling of your broaches may tie up production. Here are a few good rules to follow to protect these vital war tools:

(a) Always provide individual storage racks for broaches. These should either be of a material that will protect the teeth from damage or else should be lined with such material. If cutting edges of broaches are allowed to strike against each other they may be chipped or nicked.

(b) Never drop a broach on any hardened surface. Broaches are usually made of high speed steel and may even be tipped with tungsten carbide. You may chip, nick, or even break the teeth.

(c) When broaches are to be stored for any period of time they should be treated to protect them against corrosion.

(d) Equipment for moving broaches from one department to another should have separate compartments to prevent nicking of broach teeth.

COLONIAL broaches are designed to enable you to machine your parts more accurately, quicker, and at a lower tool cost per piece than with virtually any other method of stock removal. Give them a chance to do an all-out job for you. Handle them carefully.

colonial BROACH COMPANY

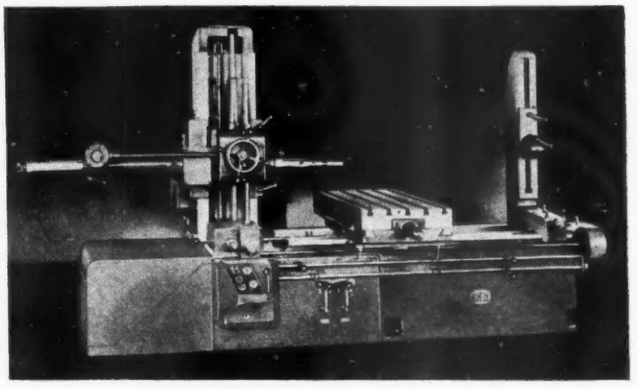
Broaching Machines — *Broaches-Broaching Equipment*

DETROIT . . . . U. S. A.

of its design; infinite variation in feed and speed is obtainable without stopping to change gears, and the method of control insures quick stops and high rates of acceleration without shock to the parts of the machine, according to the manufacturer.

Owing to the infinite speed variation, the machine can always be run at the proper speed, unhampered by the limitations of stepped gears, and the most work can be gotten out of the tools. The machine is brought to a quick stop by dynamic braking, whereby time and tools are saved.

A two-speed rapid traverse facilitates "inching up" to the work at a low rate, or at a high rate when a considerable motion is required. The main spindle is driven directly from a motor, while another motor drives the feed through a positive clutch. Milling cutters and other attachments may be bolted directly to a flange on the outer end of the spindle.



Simplified controls are featured in the design of this Yoder horizontal boring mill.

SANDING and finishing operations on aircraft and parts now are being performed with labor-saving portable sanders. The accompanying illustration shows a typical sanding operation where a combination mattress and air pad is used on the sandpaper attachments of a portable sander for the proper abrasive cut of the curved abrading surface. The entire propeller is properly smoothed and finished, and with the proper grits of aluminum-oxide open-coat paper or cloth, costs are sharply cut and production is increased. For sanding the sealer coat for removing orange peel, pock and dirt, No. 240 grit aluminum oxide-coat abrasive paper is used. This operation is important because of the blemishes which stand out in the final finish if care is not taken to remove such particles and prepare the surface for the lacquer or varnish application.



Sundstrand sander for rapid finishing of wooden parts.

On the final lacquer- or varnish-finishing operation, either No. 360 or No. 400 wet or dry abrasive paper, with a mixture of oleum spirits and rubbing oil or flax soap and water, will give the proper cutting action. Then, to obtain a high luster, this is followed by a compounding operation with soft pads on the portable sander.

These machines operate at approxi-

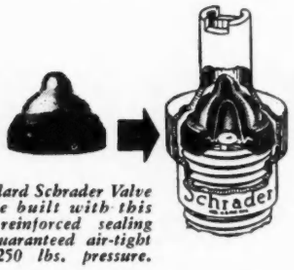
(*Turn to page* 187, *please*)



THE ROAD TO VICTORY

IS NO PLACE FOR A "FLAT"

A flat tire can delay the movement of troops, weapons or supplies. It can be the cause of wasting perishable foods, or it can keep war workers from their vital jobs. Today, if a flat results from preventable causes, it is carelessness of the most serious kind. Flat tires due to valve leakage *are* preventable. Air cannot escape through tire valves sealed with air-tight Schrader Valve Caps. The road to Victory is no place for a flat. Be sure the valves you service are sealed with air-tight Schrader Caps.



All Standard Schrader Valve Caps are built with this doubly reinforced sealing unit. Guaranteed air-tight up to 250 lbs. pressure.

Schrader

REG. U.S. PAT. OFF.

VALVE CAPS

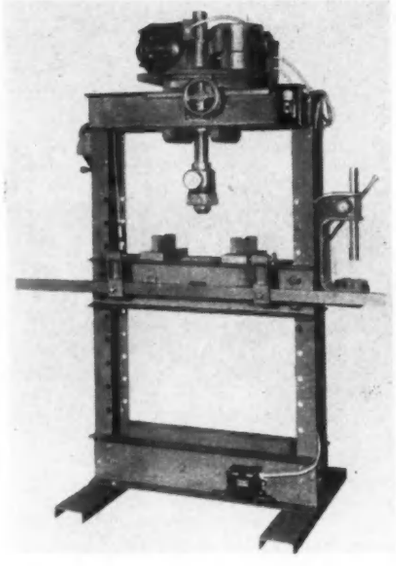
GUARDIANS OF THE AIR THAT HELP SAVE RUBBER

A. SCHRADER'S SON, *Division of Scovill Manufacturing Company, Inc.*, BROOKLYN, N. Y

(*Continued from page* 182)

mately 3000 strokes per minute, as compared to 150 hand strokes per minute of the average operator, which is indicative of the advantage of the mechanical method. These portable sanders, which are a product of the Pneumatic Machine Division of Sundstrand Machine Tool Co., are used in the aviation industry by fabricators of wings, stabilizers, noses, and aircraft parts.

LEMPCO Pressurematic electric presses are built by Lempco Products, Inc., Bedford, Ohio, in two sizes, of 40 tons and 60 tons capacity. A feature of these presses is their automatic pressure control. The operator sets the dial gage to any pressure he desires, and when this pressure is reached, the power is automatically cut off and the ram stops. The machine may be set to back the ram off the work automatically, and even to raise it to a certain height and then return it again, thus



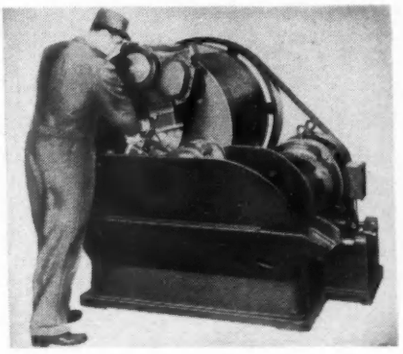
Lempco electric press with hand-operated arbor press attached to the side column.

giving a repeat action similar to that of a punch press.

The Lempco Pressurematic is also made in 40-ton and 60-ton hydraulic models. These have two pumping speeds, the change-over from one speed to the other being made by turning a knob. Other features include an adjustable work head and bolster, a 7-in. ram travel, a breach-lock type of ram screw, and I-beam frame construction.

OVERARM MACHINE CO., Chicago., has announced the Overarm automatic turning and boring machine, which is made in five series and is adapted for the rapid machining of shells on the one hand and for machine operations on engine cylinders and pistons on the other. Series 100 has a capacity of 57 to 105 mm diameter; Series 200 of 5 to 8 in.; Series 300 of 9 to 12 in.; Series 400 of 14 to 16 in.; and Series 500 of 18 in. Among special features of the machine may be mentioned the following: It is extremely rigid, has no drive gears, and is designed for the use of carbide tools; it is equipped with preloaded roller bearings and works on an automatic cycle, consequently can be operated by inexperienced labor.

Overarm turning and boring machine especially adapted to the rapid machining of shells, engine cylinders, and pistons.



GOVERNORS
for ALL PURPOSES

Increased production in many fields, to meet present demands for defense and offense, has created delivery problems with which some suppliers have been unable to cope.

The war program has stepped up our production repeatedly — for Hoof Governors will be found on such diversified equipment as trucks, ambulances, fire fighting equipment, arc welders, air compressors, tractors, loaders, saw mills, feed mills, gasoline driven locomotive.

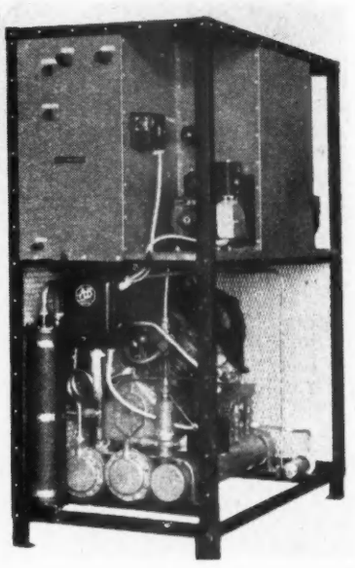
Whatever your equipment may be . . if it is controlled by a governor, we should be a source of supply. Complete engineering facilities to furnish just what you need; production facilities for getting it to you on schedule . . and at the right price.

HOOF PRODUCTS COMPANY • CHICAGO, ILL.

HOOF GOVERNORS

FAIRBANKS, MORSE & CO., Chicago, announces a new cabinet unit known as the Fairbanks-Morse spot-welding tip cooler. It is a self-contained cooling apparatus which circulates a non-corrosive, non-precipitating solution through the welding tips of a spot welder. It is claimed to permit faster, cleaner welding, and is said to have enabled aircraft plants to greatly increase the number of spot welds between tip cleanings.

Operating as a refrigerating machine, the unit comprises two pumps driven by motors having cycling overload relays. A group circulating pump, operating continuously with the compressor, circulates Freon 12 refrigerant through the evaporator for high heat transfer. An F-M turbine-type pump circulates a solution of high specific heat from the unit to the welding tips and back to the unit. This pump, which has a high-pressure cutout, is controlled by a manual switch. A thermostatically-controlled four-cylinder V-type compressor also is equipped with a cutout. Its motor is protected by an overload device in the automatic starter.



Fairbanks-Morse spot-welding tip cooler.

DANLY KWIK-KLAMPS

TOGGLE CLAMPS FOR QUICK, POSITIVE CLAMPING IN ANY POSITION WITH

STANDARD HALF TURN

OR STRAIGHT CLAMPING BAR

WRITE YOUR DANLY BRANCH

DANLY MACHINE SPECIALTIES, INC.

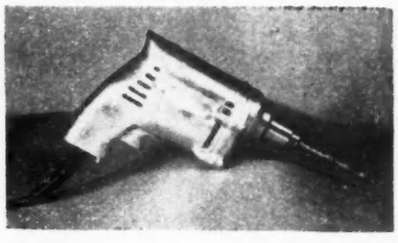
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Long Island City, N. Y. Detroit, Mich. Cleveland, Ohio
Philadelphia, Penna.

Ducommun Metals & Supply Company, Los Angeles; San Francisco

DANLY DIE SETS and DIE MAKERS' SUPPLIES

A NEW electric drill is being offered by Mall Tool Co., Chicago. It is designed for continuous duty under full load, and the pistol-type grip and trigger switch permit operation by either the right or left hand. The tool can be operated on either 110- or 220-volt alternating current of 25 to 60



Mall electric drill for operation on either 110 or 220 volts, 25 to 60 cycles.

cycles, and comes with 10 ft of rubber covered three-wire cord. The armature is statically and dynamically balanced, and all shafts are carried in precision ball bearings packed in grease. The drill has a capacity of up to ¼ in. in steel.

A NEW type of heat-treating furnace employing 100 per cent forced convection heating with a temperature range from 250 F to 1750 F, developed by Lindberg Engineering Co. of Chicago, is said to make possible increased production in hardening, normalizing, annealing, tempering, nitriding, and other heat-treating operations in this temperature range. This new furnace, the Super-Cyclone, is said to be the first furnace developed that heats exclusively by forced convection at 1750 F. A high-velocity fan forces the heat through every part of the charge, ensuring uniform heating and preventing distortion.

In the illustration is shown a fixture carrying 63 bearing races of SAE No.

(*Turn to page* 192, *please*)

succeeding year!



Jones & Lamson Automatic Thread Grinder, model TG-636 (6 x 36″).



Jones & Lamson Automatic Thread Grinder, model TG-1245 (12 x 45″).

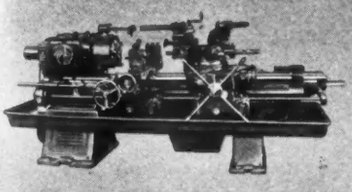
PROFIT PRODUCING
MACHINE TOOLS

JONES & LAMSON

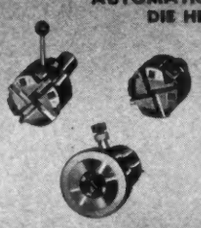
MACHINE COMPANY - SPRINGFIELD, VERMONT, U. S. A.

MANUFACTURERS OF: RAM & SADDLE TYPE UNIVERSAL TURRET LATHES . . . FAY AUTOMATIC LATHES . . . AUTOMATIC THREAD GRINDING MACHINES . . . COMPARATORS . . . AUTOMATIC OPENING THREADING DIES AND CHASERS

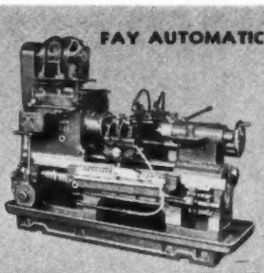
SADDLE TYPE
UNIVERSAL TURRET LATHE

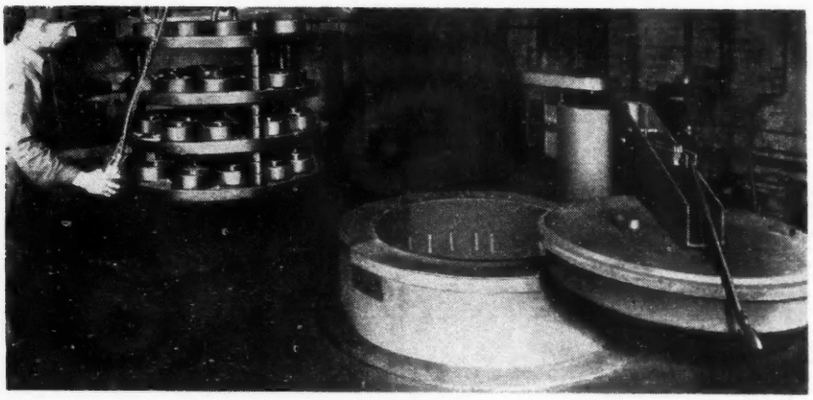


AUTOMATIC OPENING
DIE HEADS



FAY AUTOMATIC LATHES





Developed by the Lindberg Engineering Co., the Super-Cyclone furnace is said to ensure uniform heating.

(*Continued from page* 188)

52100 steel being charged into the furnace. When they are heated through, the races are taken from the furnace and quenched, with the fixture. With the new method the races remain on the fixtures during both the heating and quenching operations, and they are tempered on the same fixture.

THE Barber-Colman Co., Rockford, Ill., is producing, on order, interlocking side mills of the staggered-tooth type. With virtually continuous tooth edges, there is practically free flow of chips across the teeth, which lengthens cutter life. Tools of this type are recommended for long, deep slotting in steel, and are specially adapted to shoulder cuts. In many cases the depth of cut may extend up to the hub, without stalling the cutter. These cutters

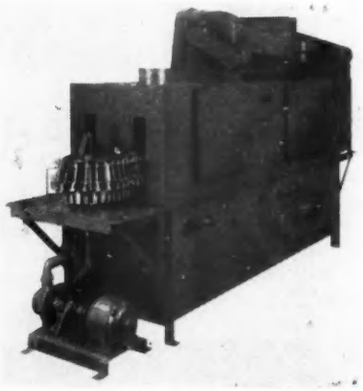


Barber-Colman tool especially adapted to shoulder cuts.

are supplied in a range of sizes from 3 in. diameter and ½-in. face to 15 in. diameter and corresponding face width.

THE Blakeslee metal-parts washing machine, which is being manufactured by G. S. Blakeslee & Co., Chicago, was designed specially for war work. It provides for a hot caustic wash and hot rinse, followed by a blow-off and dryer. Parts are loaded by hand at one end of the machine, and automatically discharged at the same end onto the chute as the conveyor re-

(*Turn to page* 198, *please*)



Blakeslee metal-parts washing machine designed especially for war production.



• • • *Unequalled* SURFACE SMOOTHNESS and SPHERICITY

The series of lapping operations performed as a matter of course in the Strom plant give Strom Steel Balls a degree of surface smoothness and sphericity that has always been unequalled in any other regular grade of ball. Only through such unique lapping practice can extreme precision be obtained.

Physical soundness, correct hardness, size accuracy, and sphericity are guaranteed unconditionally in all Strom Balls.

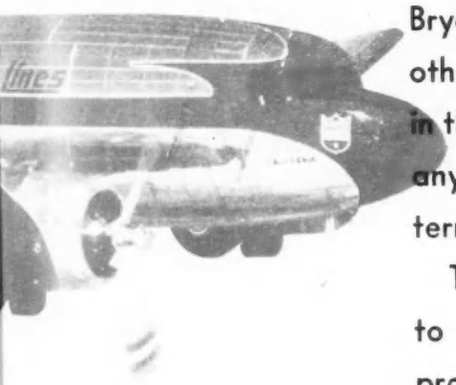
Other types of balls—*stainless steel, monel, brass* and *bronze*—are also available in all standard sizes. Write for catalog and prices.

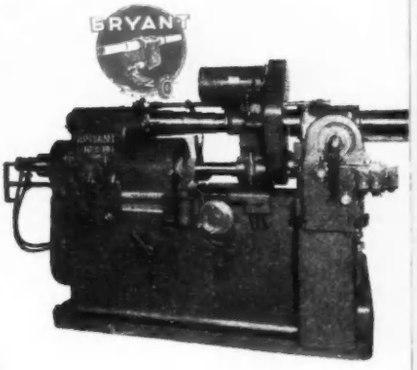
Strom STEEL BALL CO.
1850 So. 54th Avenue, Cicero, Ill.
The largest independent and exclusive Metal Ball Manufacturer

HAS a problem of internal grinding got you bottle-necked? Are there too many operations, too much lost time, too many spoiled pieces?

Then rush it by air mail to Bryant. In these hectic days your own engineers have problems enough without losing sleep over this.

Rush it by air mail to Bryant. Not only does Bryant specialize on internal grinding equipment. Not only has Bryant production already tripled, it is constantly increasing. Not only is Bryant all out for war production. There's another factor—Bryant's *specialized* experience in this highly specialized field is unmatched by any other organization devoted solely to internal grinding problems.





That's why it pays to air mail your problems to Bryant. Whether you're striving for war production today or studying how to cut costs and earn profits on new products for future markets, Bryant wants to help you. The thing to do with an internal grinding problem is rush it by air mail to Bryant.

BRYANT CHUCKING GRINDER CO.

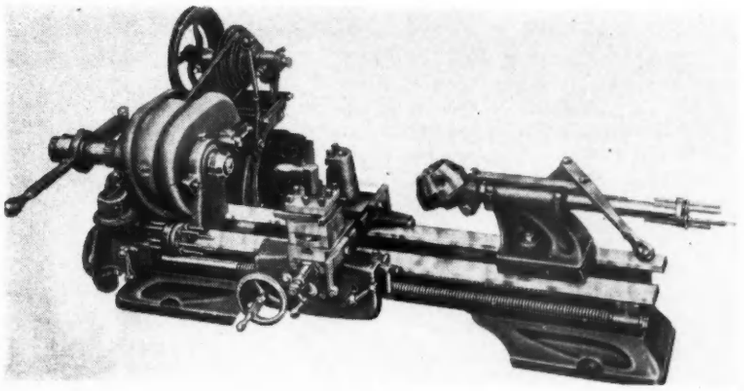
SPRINGFIELD, VERMONT, U. S. A.

Air Mail to Bryant

(*Continued from page* 192)

turns. The conveyor with the fixtures is a complete unit and can be removed from the machine. The machine illustrated has adaptors for 20-, 37-, and 40-mm projectiles, as well as for 20-mm cases, of brass and steel. On the smaller cases the production is up to 3000 per hour. Several machines of this type are used in one production line, for cleaning of parts at various stages of their production.

THE Atlas 10-in. lathe of the Atlas Press Co., Kalamazoo, Mich., is now being equipped as a universal turret lathe-screw machine. The special equipment includes the following production attachments: A quick-acting, lever-type collet chuck for the instant chucking and releasing of bar stock up to ½ in. diameter; a carriage turret with four-way tool post; a cut-off tool post and multi-stop attachment for quickly gaging the length of cut; and a tailstock turret head with lever control, and provision for six tools and six stop screws for limiting the depth of each cut. Indexing arrangements speed up tool rotation. The machine is equipped with a universal chuck for turret-lathe work on larger pieces.



Atlas 10-in. lathe equipped as a universal turret lathe.



MORE THAN 41,000,000

STERLING PISTONS...

have been giving unsurpassed service in hundreds of thousands of America's best known internal combustion engines, including bus, truck, passenger car, tank, airplane, and marine engines. An inherent desire to do the best possible job plus the experience of building 41,000,000 pistons has given Sterling engineers the ability to design pistons that get the most power and stamina from an engine.

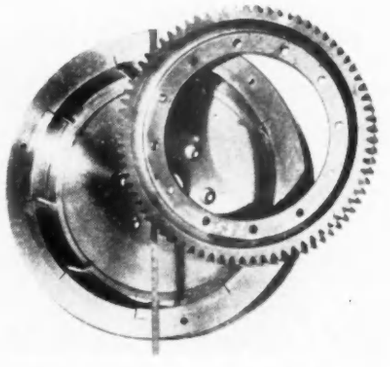
A simple request will bring you the services of an experienced Sterling engineer.

STERLING ALUMINUM PRODUCTS
Incorporated St. Louis, Mo.

LET'S GO! U.S.A. KEEP 'EM ROLLING

STERLING
PISTONS

THE Cotta Speed Chuck is being offered by Charles Cotta of Rockford, Ill., as a means for holding spur or helical gears for hub, hole, or face grinding and other comparable operations. Loading and unloading time is reduced to a minimum, because the gear is simply set into the chuck, and a slight turn causes it to be gripped firmly by a set of hardened and ground pitch-line pins. These pins bear against a set of accurately ground eccentric cams which are placed to tighten against the normal direction of rotation. The gear is released by a slight turn in the opposite direction.



Cotta Speed Chuck for holding spur or helical gears.

With the Cotta Speed Chuck, accu-

Measuring Up To This BIGGER WAR JOB



● Among the big names in aircraft is Lycoming, the sensational aircraft engine that powers training units and many other types of airplanes. The picture shows Lycoming-powered Boeing training planes on the line at Randolph Field, "The West Point of the Air". The Bunting Bronze Bearings illustrated represent revolutionary innovations in bearing design and production, and are typical of those supplied in great volume to Lycoming and others.

The Bunting organization is abreast of present-day progress in the field of aviation, ready and able to help you with any bearing problem... The Bunting Brass & Bronze Company, Toledo, Ohio. Warehouses in All Principal Cities.

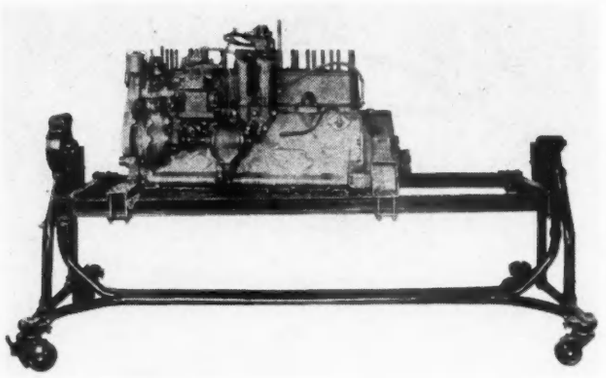




Bunting

BRONZE BUSHINGS • BEARINGS • PRECISION BRONZE BARS

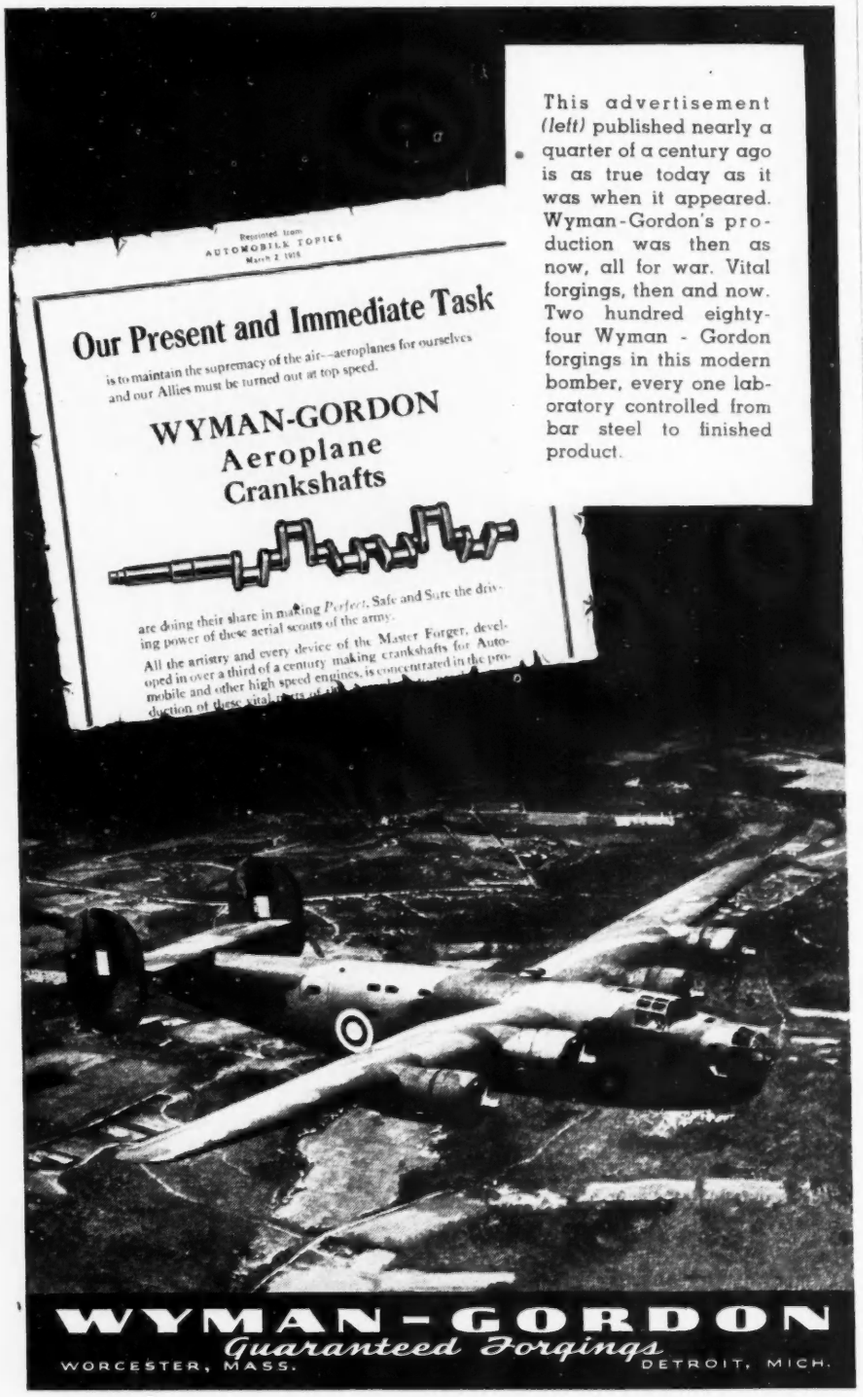
rate alignment is obtained automatically, because the pins are sized to bear on the pitch lines, and the cams are carefully ground to ensure concentricity. Each Speed Chuck is specially designed for the job it is to be used on, which makes it primarily a production tool. Various types are available for single or cluster gears, in sizes ranging from 3 to 36 in. in diameter.



Collapsible engine stand built by Motor Rebuilding Specialties.

EXPERIENCE during the present war has emphasized the need for the conservation of cargo space. As a move in this direction, Motor Rebuilding Specialties, Chicago, Ill., has developed a new engine test stand which, without any sacrifice in rigidity, can be disassembled by removing only eight bolts. This permits the folded stand to be stored in a space only one-fifth as large as the space occupied by the assembled stand.

Engine stands using this feature are available for both in-line and radial engines weighing up to 3000 lb. They are made of heavy steel tubing and angle iron. A 48 to 1 gear ratio permits easy rotation of the cradle to any convenient operating position.



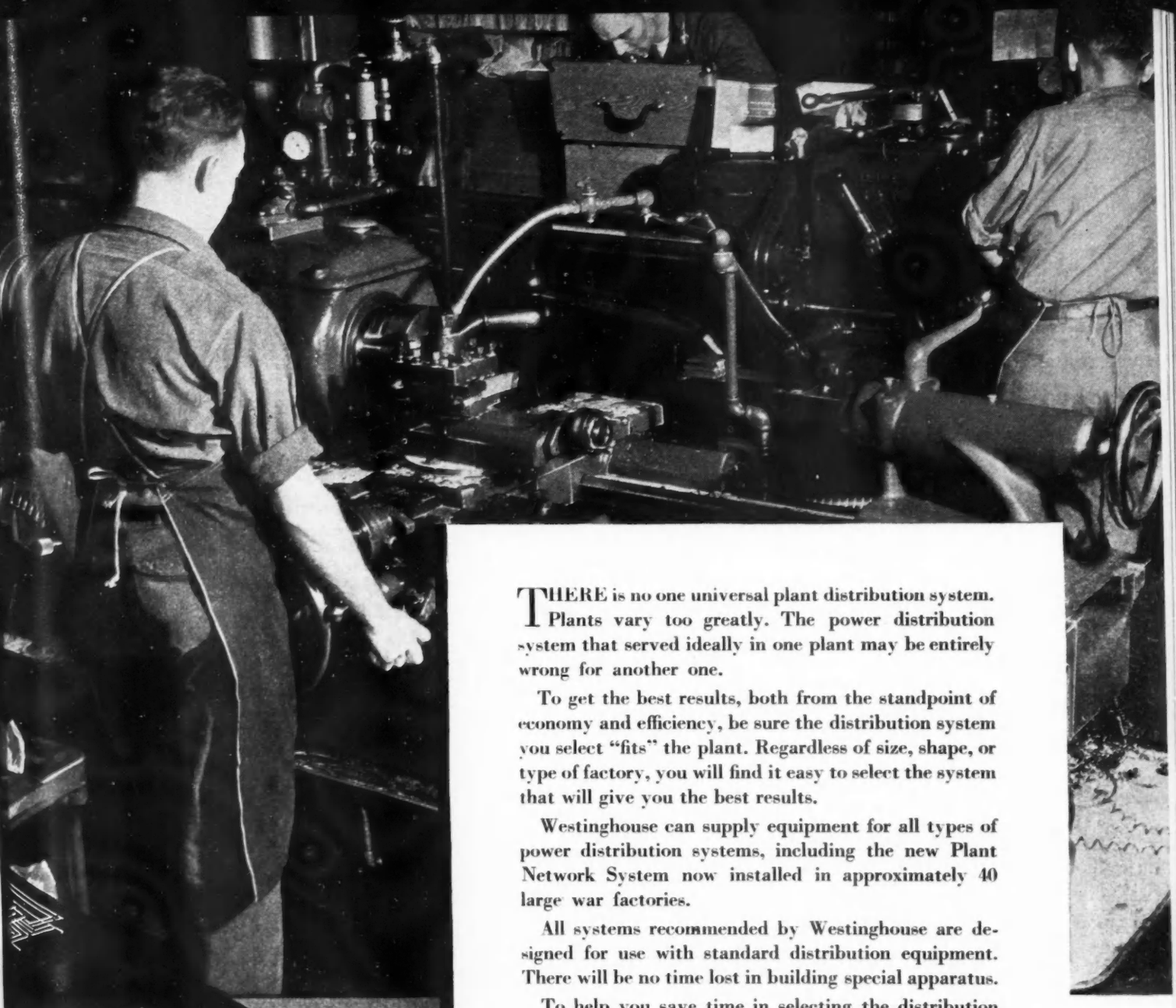
THE Shallcross Aero-Gun bond tester, manufactured by the Shallcross Mfg. Co., Collingdale, Pa., is used to test an electrical bond by measuring its electrical resistance. For this operation a wheatstone bridge would be used normally, but under modern conditions it is necessary that the testing be done by personnel without techincal training. The Shallcross instrument meets these requirements. Exploring probes extend from the muzzle of the "gun"; the battery is in the barrel; the indicating meter and control equipment are in the butt; and the cable to the fixed clamp is attached to the pistol grip. The instrument can be handled by one man without technical training.



Shallcross electrical bond tester.

THE Onsrud spar miller (Onsrud Machine Works, Inc., Chicago) was designed and built to mill the long extrusions or billets from which wing spars or similar long parts are made. Lengths up to 38 ft are machined in

(*Turn to page* 204, *please*)



THERE is no one universal plant distribution system. Plants vary too greatly. The power distribution system that served ideally in one plant may be entirely wrong for another one.

To get the best results, both from the standpoint of economy and efficiency, be sure the distribution system you select "fits" the plant. Regardless of size, shape, or type of factory, you will find it easy to select the system that will give you the best results.

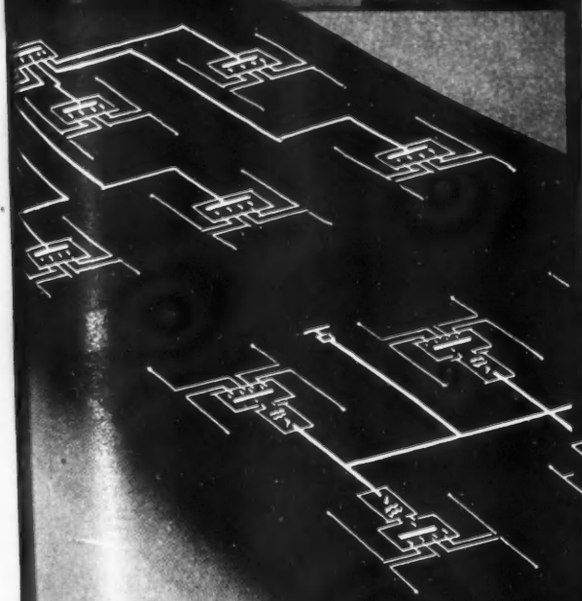
Westinghouse can supply equipment for all types of power distribution systems, including the new Plant Network System now installed in approximately 40 large war factories.

All systems recommended by Westinghouse are designed for use with standard distribution equipment. There will be no time lost in building special apparatus.

To help you save time in selecting the distribution system that best fits your requirements, Westinghouse has prepared a special book that briefly describes a group of different plant distribution systems. Just fill in and mail the coupon for your copy.

If you want faster action, call our local office. One of our engineers will be glad to discuss your distribution problem with you.

Westinghouse Electric & Manufacturing Co.
East Pittsburgh, Pa.





FREE QUICK FACTS ABOUT PLANT DISTRIBUTION SYSTEMS

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Please send book B-3152 giving quick facts on Westinghouse Distribution Systems.

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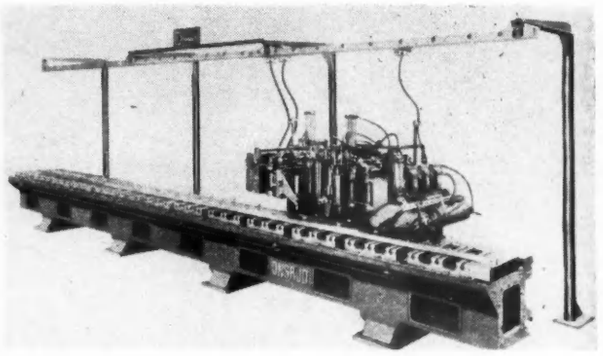
Address _____

City _____ *State* _____ J-94511

(*Continued from page* 200)

one set-up. Carriage speeds can be varied from 2 in. to 19 ft per min. Equipped with one horizontal and two vertical cutters, the machine can perform as many as three operations at one time. Each cutter is guided by a template. The horizontal cutter turns at 5400 rpm, while the vertical cutters turn at 10,800 rpm.

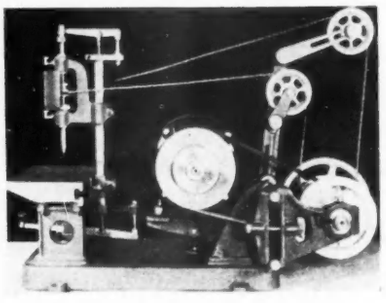
The bed is made up of 15-ft sections, and as many of these bed sections may be assembled end-to-end as the work necessitates. Since each vertical head is pivot-arm mounted, and moves on a 6-in. radius, scallop work also may be performed. These same cutters are used for hogging when the work requires it. Various types of air and air-hydraulic clamps are available for quickly clamping and releasing the work in the jig. The vertical high-cycle cutter motors are equipped with the Onsrud patented centrifugal-force-feed lubrication system.



Onsrud spar miller.

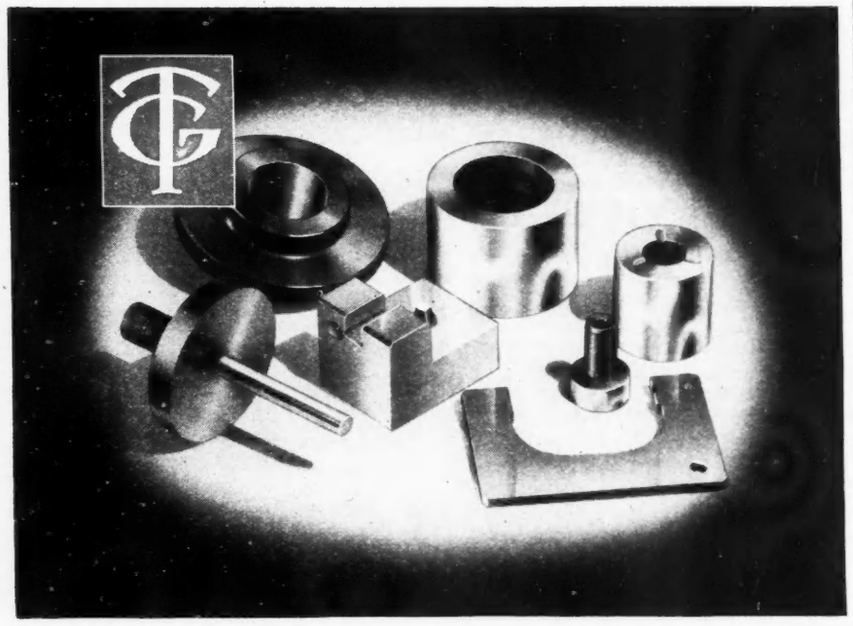
Recently spar millers have been equipped with the G.E. Thy-mo-trol. With this mechanism the travel speed of the carriage is automatically controlled. Variable-angle attachments for the vertical heads are available for such machining operations as twist cutting.

A SUPERSENSITIVE drill press for extremely small drills and other tools is announced by the Edward Blake Co., Newton Centre, Mass. The machine has a standard range of eight speeds, from 3000 to 23000 rpm, which gives the proper surface speeds on drills from 0.004 to 1/16 in. diameter. Sensitivity is attained by balancing the spindle by means of the vertical component of the belt tension. This sensitivity, plus convenient finger-tip control, reduces drill breakage. Machines can be furnished with one, two or three, and four spindles. Each spindle is furnished with an independent finger-tip control and each spindle may be run at an independent speed to suit the size and type of tool being used and the material to be cut.



Blake supersensitive drill press.

A RADIAL type gun spot welder (Model P-1-R) is now being offered by Sciaky Bros. of Chicago in both stationary and buggy-mounted units. It is equipped with a special Sciaky



TURNER
A
Name to Remember
for
PRECISION GAUGES

For snap, ring, plug, flush pin and special gauges, Turner is the name to remember.

TURNER GAUGE GRINDING COMPANY
2622 HILTON ROAD • • • • FERNDALE, MICH.

40 Pages of "KNOW HOW"...ideas that are helping speed production in leading aircraft and accessory plants



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You have done costly engineering, tooled-up and geared-up, to save time on many production operations. But have you looked into the possibility of saving from valuable minutes to precious hours on your production cleaning jobs? It's easy to investigate. The "know how", based on the experience of leading aviation manufacturers in more than 50 different types of work and operations, is concisely reported in the NEW 40-page Oakite manual that is yours for the asking!

OAKITE DEGREASING and CLEANING MATERIALS

are performance-proved in the Aviation Industry. Below are just a few of the many successful uses described in the NEW Oakite manual.

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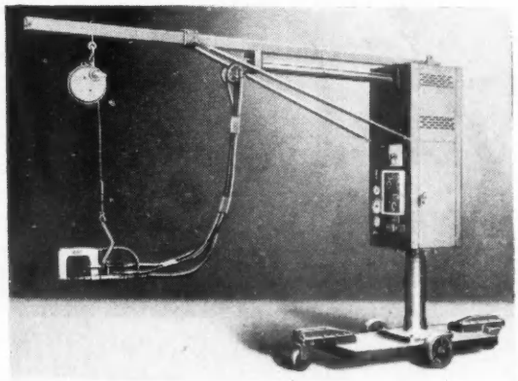
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welding timer and operates on single-phase alternating current of 220 or 440 volts. Hydraulic pressure is supplied by a hydro-pneumatic booster, which can feed a gun able to supply a maximum electrode pressure of 1800 lb when actuated by a pressure of 90 psi. Fixed or crowded jigs can be reached with the portable, buggy-mounted welding gun. The maximum area reached by the stationary unit is that of a circle of 21 ft diameter.

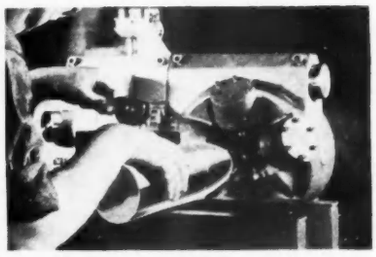
Water-cooled fixed copper bars in the secondary circuit make possible the use of thin, short, flexible secondary cables. Under production conditions this welder is said to be able to weld corrosion-resistant steel, pickled steel, zinc-coated steel, and monel metal in thicknesses of from 0.016 in. plus 0.016 in. up to 0.064 in plus 0.064 in. It will also weld two unequal thicknesses up to a total welded thickness of 0.500 in., provided one of them does not exceed 0.040 in. In welding pickled mild steel or standard steel, a speed of 180 spot welds per min can be attained on thicknesses up to 0.032 plus 0.032 in.



Sciaky Model P-1-R spot welders.



A MULTIPLE-SPINDLE head for simultaneously milling a number of staking notches in shell noses has been placed on the market by Kent-Owens Machine Co., Toledo, O. The illustration shows a five-spindle head. This method multiplies production as compared with the former one of milling one notch at a time. This unit can be adapted for use on either a Kent-Owens No. 1-8 machine with hydraulic table feed, or on the No. 1-M machine with hand feed.



Kent-Owens five-spindle milling head.

A NEW electriconic crest voltmeter announced by the General Electric Co., is designed to measure ignition voltages of internal combustion engines, surge voltages caused by corona and surface discharges in the insulation on such electric equipment as motors, generators, and cables; and other repeated-impulse voltages up to 30,000. The instrument weighs 23 lb, and serves as a portable crest voltmeter for both laboratory and production testing. It is suitable for field testing and can be used also for testing the electrical equipment of aircraft engines in flight. As it has a self-contained battery sup-

It's healthier on the Attacking Side

Whether you're fighting a Jap 5 miles up or tackling a problem in the shop . . . it helps a lot to have the jump on your competitor.

ALTER EGO: True as gospel. Competition forces progress. We've changed over to welding of ships, planes, tanks and guns. Why? Because the Axis had a head start in designs and output. They *forced* us to make 'em better and build 'em faster.

Imagine that! It took a threat to our very lives to drive home the necessity of converting old methods to new!

ALTER EGO: But have we learned our lesson? Will we be content to plod along after this scrap is over? As for me, I'm going to convert now to the offensive for tomorrow's Battle for Business.

That's the spirit! Let's take off our rose-colored glasses and put on our reading glasses. Let's learn all about welding so we can get the jump on competition.

THE LINCOLN ELECTRIC COMPANY
CLEVELAND, OHIO

ALTER EGO: Literally, "one's other self"— the still, small voice that questions, inspires and corrects our conscious action.

Photo Courtesy: Lockheed Aircraft Corp.





NEW Southern Engineering Metal Forming Machine SPEEDS-UP Extrusion Forming by 5200%

"Revolutionary" is what production engineers say about this high speed method of forming bulkhead rings and other heavy gauge extrusions. For the first time in aviation history, extrusions are now being formed on a machine-production basis—with amazing increases in output per man-hour.

HANDLES EXTRUSIONS up to 15' in length, or from 4" to 11' in diameter...

With correct application on each of the four heads, the following work can be produced: Practically any type extrusion ... with reverse curves, slow sweeps, off-sets, compound curves and joggles. Some flat sections and all kinds of power brake or rolled sections.

Forms Many Parts TWO OR MORE AT A TIME

Prominent aircraft builders now using these machines often form two mating parts at-a-time—frequently machine-producing up to 90 parts per hour that formerly required 35 minutes each to hand form. That is almost like forming extrusions *by magic!* ★ ★ ★ Because special equipment must be designed for special work, we suggest you *submit your problems* for engineering determination. Write for complete data on your company letterhead.

SEC

P.S.—WATCH FOR IMPORTANT ANNOUNCEMENT IN NOVEMBER ON SPECIAL, NEW TYPE METAL FORMING MACHINE VITALLY IMPORTANT TO YOU!

SOUTHERN ENGINEERING CO., INC.

Aircraft Production Equipment

816 WEST FIFTH STREET, LOS ANGELES, CALIFORNIA

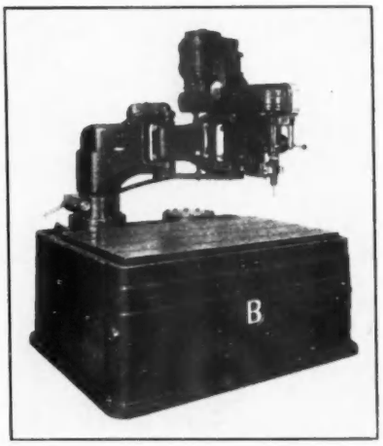


G-E crest voltmeter for measuring repeated impulse voltages.

ply it is independent of electric power lines.

The voltmeter is equipped with an aircraft-instrument movement to provide resistance to vibration. It can be supplied marked and calibrated for any of the following scale ranges: 0-10,000 volts, 0-20,000 volts, 0-30,000 volts.

THE Blakewell Manufacturing Co., Los Angeles, Calif., has designed a precision tapping machine for large and bulky pieces of work where Class 3 and 4 gage fits have to be produced on a production basis. The machine has a heavy cast-iron base on which is mounted a hydraulically operated column giving a maximum height clearance of 28 in. and a radius clearance of nearly 37 in. Free-floating on this



Bakewell precision tapping machine for large and bulky parts.

column is the arm which holds the tapping head and which can be swung around within limits for work either on the horizontal working table or work which has been clamped to either the end or the rear vertical table.

A SERIES of dynamic balancing machines has been announced by the Bear Manufacturing Co., Rock Island.

HOW GOOD A SCRAPPER ARE YOU ?



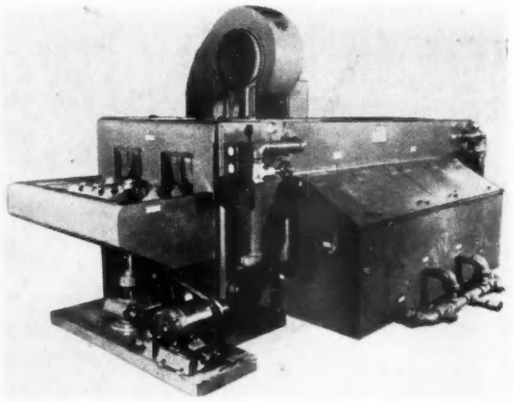
How about taking *another* sock at the Axis—aside from the healthy punches you're delivering with war production? Round up all the iron and steel that it's not absolutely essential to keep. Do it both at the plant and at home. Then turn it in for scrap, even if some of it hurts!

In plain words, here's the picture. Steel producers are going to need several million *more* tons of scrap this year than ever before. If we don't get it, you won't get enough *new* steel; and if you're pinched, it's the boys on the fronts who will suffer. • It can be either a vicious or victorious circle. *Will you do your share—and more—to make it the latter?*

Allegheny Ludlum
STEEL CORPORATION
GENERAL OFFICES: PITTSBURGH, PENNSYLVANIA

Hl. These machines indicate both the angular position and the magnitude of any out-of-balance. When they are used, it is unnecessary to make a preliminary static balance test, since the machines reveal whether static or dynamic unbalance is present without turning the body being tested end-for-end.

These Bear machines are available in a number of models ranging from bench models to large floor- and pit-type models, for balancing such rotating parts as armatures, fans, blowers, flywheels, hubs, drums, propellers, gears, impellers, pulleys, wheels, rotors, etc., ranging in weight from 6 oz to 1000 lb.



Magnus shell-washing machine.

THE Magnus washing machine will wash, rinse, dry, and cool up to five-hundred 75-mm shells per hour while being operated by one man. It will also wash, rinse, dry, and cool up to fifteen hundred 50-mm, two thousand 40-mm, or twenty-five hundred 37-mm shells per hour, but to adapt it to the handling of these smaller shells, certain alterations must be made in the shell carrier and the spraying system, and two operators are required. This machine is being manufactured by the Washing Machine Division of the Magnus Chemical Co., Garwood, N. J.



Littelfuse Be. Cu. Fuse Clips on No. 1505 Universal panel for glass enclosed fuses (3 AG, 4 AG, 5 AG), showing 1-pole and 3-pole types.

In Most Severe Service
LITTELFUSE
Beryllium Copper Fuse Clips
are setting amazing new records in



(1) Fatigue Resistance
(2) Tensile Strength
(3) Modulus of Elasticity
(4) Heat Resistance
(5) Spring Qualities equal to Steel
(6) Triple the grip of best phosphor bronze

Hundreds of thousands delivered to aircraft plants, Army and Navy.

TECHNICAL BULLETIN NOW READY!
Write for new bulletin giving complete technical data, properties, specifications, sizes, characteristics.

LITTELFUSE INC.
First in Aircraft Fuses — Pioneers in the Industry.
4731 RAVENSWOOD AVE. CHICAGO, ILL.

The Role of Metals In the War

(*Continued from page* 63)

If they get any tin from there, what are they going to do with it? Their own industry isn't going to be helped very much, lacking, as they do, other vital metals. While it is the patriotic duty of all Americans to get behind the drive for every pound of tin scrap, it is only fair to record that the tin situation in the United States is much more satisfactory than we had any right to expect after the Straits Settlements and Dutch East Indies fell into enemy hands. Essential war requirements are being fully met, and on time.

Every one is more or less "sold" by this time on the notion that gaps in the supply of materials are responsible for slowing down the pace of war production, which is only another way of saying that the mechanical capacity of fabricating plants is such that it outstrips the supply of raw materials. When all is said and done, though, it will have to be admitted that the primary metal industries have done a bang-up job, considering that they have had to supply much of the material for equipping the fabricating plants with the necessary machinery. It's another case of the chicken and the egg. Which came first?



It's NEW

HELP FOR THE MAN ON THE MACHINE

Tools for various machining operations, tool shapes, cutting speeds and feeds, cutting compounds, characteristics of the different Aluminum Alloys; all these things are discussed in this new book, "Machining Alcoa Aluminum".

Beginners and experienced machinists will find this book equally valuable. It may contain your key to faster, higher quality production of badly needed war materiel.

Alcoa engineers continue to be available to assist you in solving new and unusual Aluminum fabricating problems. They'll also gladly counsel with you on your postwar thinking. For this help, and for copies of this new book, "Machining Alcoa Aluminum", write ALUMINUM COMPANY OF AMERICA, 2110 Gulf Building, Pittsburgh, Pa.

ALCOA ALUMINUM

New Materials

(*Continued from page* 95)

solvents; compatibility with most plasticizers including the oils; compatibility with a wide variety of natural and synthetic resins; retention of toughness and flexibility of compositions from very low to very high temperatures; inertness to chemical influences such as alkalies, weak or dilute acids, and salts; excellent stability under sunlight and heat; good electrical characteristics; low order of flammability; and excellent plasticity. Because ethyl cellulose combines this wide range of desirable properties, it is useful in a variety of lacquers, plastics, films, foils, quick-drying varnishes, and adhesives.

Mineral-Filled Resin for Electrical Parts

A mineral-filled melamine resin known as Melmac P-592 molding compound is now being offered for ignition-set moldings by the American Cyanamid Co., New York, N. Y. The material has outstanding arc-resistance and high dielectric strength at both moderate and high temperatures, and so far it has been used chiefly for aircraft distributors and magnetos.

In the molded state the material has a specific gravity of 1.76-1.78. The Izod impact strength (A.S.T.M. method) is 0.305 ft-lb per in. of notch; the flexural strength, 9500 psi; the deflection, 0.030 in., and the shrinkage in molding, 6.0 mils per in. The material is not recommended for use where it is exposed to a temperature exceeding 300 F. As molded, at 100 C, the dielectric strength is 375 volts per mil, while at 25 C it is 445 volts per mil. The average arc resistance is 135 by the A.S.T.M. method, while after 8 hr at 300 F it is over 158. The power factor (at 60 cycles) is 11.0 to 12.0 per cent; the dielectric constant (60 cycles), 8.2 to 8.7, while after heating for 12 hr at 270 F the power factor is 4 per cent and the dielectric constant 6.4.

New Anodic Degreasing Material

Specially designed to meet war demands for faster cycles in anodic degreasing or reverse-current cleaning of cold-rolled steel parts before finishing, a newly-developed alkaline type of material has been announced by the Technical Research Laboratories of Oakite Products, Inc., New York, N. Y. Known as Oakite Composition No. 90, this new material is said to provide several original features which mark it a basic contribution to faster production, more nearly uniform results, low unit cost and long solution life. Due to its high conductivity, ready adaptibility to hard-water conditions, effective smut-removing properties, and fast wetting-out action, the material is said to fully meet requirements where large volumes of work must be handled. It is claimed to have been found advantageous particularly in plating departments using the Bullard-Dunn process for tin-coating of steel parts.

Rust-Preventive

Curran Corporation, Malden, Mass., has introduced a rust-preventive known as Polar K oil, which is claimed to completely remove perspiration, water, oil, and dirt from steel surfaces. It is said to be superior to alcohol for dehydrating and cleaning steel surfaces, bearings, and similar parts which have become wet or have been left with a film of grinding emulsion. The oil is said instantly to displace and absorb water and to leave a thin film of Polar type lubricant and rust-preventive. It has been found suitable for spraying the inside of Diesel and gasoline engine cylinders on which a film of condensed moisture may have accumulated as the result of storage in a damp atmosphere. It is being used also for flushing crankcases to remove sludge, moisture and acid salts. Polar oil is said to be completely soluble in hydrocarbons and lubricating oil, and

IT PAYS TO

Standardize

ON

HALLOWELL

SHOP EQUIPMENT

"Joe tells me you doubled your assembling capacity. Built an addition?"

"No—just re-arranged our 'Hallowell' Work-Benches. It's easy as pie."



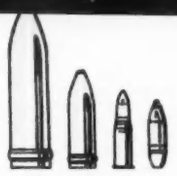


One of the advantages of standardizing on "Hallowell" is that you can re-arrange and add to your set up at any time to meet greater needs or changed requirements. They are of sturdy construction and easy to install, too. Our catalog shows many of the 1367 combinations available.



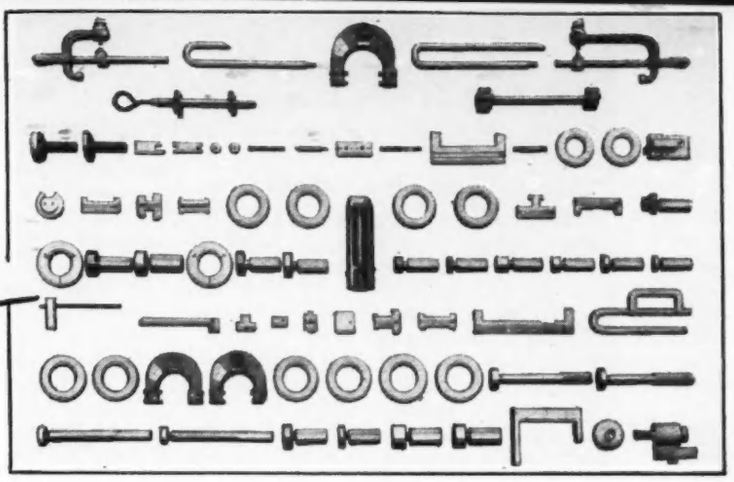
Fig. 928
Pat'd & Pat's Pend.
Drawer is extra

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YOU CAN INSPECT PROJECTILES AND SHELL CASES THIS WAY

Checking each dimension separately and laboriously with its own fixed size gage requires many inspectors and lots of time. This set of gages was used in checking the critical dimensions of a 75 mm. shrapnel body.



But HERE'S A BETTER And A FASTER METHOD

This Multichek gage checks both tolerance limits on eight critical shell dimensions simultaneously—at just one pass and far more accurately than with fixed size gages.

In just one operation this gage checks the overall length of a cartridge case, two body diameters, one flange diameter, one shoulder height, one flange thickness, one counterbore diameter, one counterbore depth, and the primer hole diameter.





Write for a Descriptive Bulletin on the SHEFFIELD MULTICHEK GAGE

THE SHEFFIELD CORPORATION

DAYTON, OHIO, U. S. A.

SHEFFIELD GAGES MASTER GAGEMAKERS

no subsequent cleaning is necessary to remove the thin film.

Solders Containing Indium

Development work looking toward the complete elimination of tin in soldering compounds has been carried on by the Indium Corp. of America, New York, N. Y. One possible substitute for the conventional tin solder is lead-silver solder, which has been known for years, but it has not come into extensive use because of its relatively high melting point and poor spreading quality. It appears from test results obtained by Electrical Testing Laboratories, New York, that the bonding strength and the spreading ability of lead-silver solders can be materially improved by the addition of small percentages of indium. Three samples, all containing 3 per cent silver, were submitted to the testing laboratories. The indium contents were 0, 1, and 2 per cent respectively. The bonding strength obtained with the solder containing no indium averaged 1710 lb, that with the solder containing 1 per cent indium, 2900 lb and that with the solder containing 2 per cent indium, 3500 lb. In comparative tests as to spreading power, the solder with 2 per cent indium spread farthest and most smoothly, while the solder without indium spread least and had a rough surface as though it had been only partly fused.



In the new plant of Aluminum Industries, Inc. is this large battery of Hydro-Whirl Magnesium Grinding Booths—which started as a unit of two booths.

The dust caused by the grinding of aircraft motor parts is extracted and knocked down into a harmless sludge by the patented Hydro-Whirl. The cleaned air is then returned to the room.

Here is an installation — like all other Hydro-Whirls — that is efficient, economical, safe, and practical.

We maintain a complete engineering department that will develop units, or complete production systems, to meet your particular requirements.

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industrial

Free-Flowing Flux for Gas Welding

An improved, free-flowing flux for gas-welding of aluminum and aluminum alloys is now being manufactured by Park Stewart, Worthington, Pa., under the trade name Flo-Ez-Flux. The manufacturer claims that as a result of improvements in the manufacturing process, it will not solidify or deteriorate. We understand this flux is being widely used in the aircraft industry. It comes in glass containers in sizes ranging from ¼ lb to 25 lb.

New A-C Welding Electrode

A new electrode specially designed for all-position welding of mild steel with a-c welding machines has been developed by Wilson Welder and Metals Co., Newark, N. J., and is supplied in diameters of 1/16, 3/32, ⅛ and 5/32 in. It is said to conform to the American Welding Society classification E6011, and the American Bureau of Shipping Group HIG and BIG for a-c welding. The following physical test results from all-weld metal tensile specimens were furnished us by the manufacturer:

	As Welded	Stress-Relieved
Ultimate tensile strength	70,000-75,000	65,000-70,000
Per cent elongation in 2 in.	25-30	30-35

Average operators are said to experience no difficulty in securing good fusion and complete penetration.

Houghton Hydraulic Oils

Realizing that the lubrication needed on oils used for hydraulic controls have far exceeded the limits of strong mineral oils, E. F. Houghton & Co., after several years of development work, has perfected a series of tested hydraulic oils under the name of "Hydro-Drive."

Starting with a combination of base oils that inherently contained as many desirable features as possible, Houghton engineers set about to improve even further these properties through the addition of stable organic compounds. The resultant oil, thus compounded, improves the wear resistant qualities by imparting additional film strength, and, contrary to most film strength additives, acts as a corrosion inhibitor, delaying the normal acid formations in mineral oils. The new oil has the property of dissolving and holding in solution any gums that may be formed.

High viscosity index, necessary to maintain proper seal at elevated temperatures, and high demulsibility characteristics were obtained through careful selection of base stocks for this oil. Foaming, aeration, and rapid increase of acid number are problems directly related to the demulsibility value of an oil, often reflected in chatter and tool breakage.

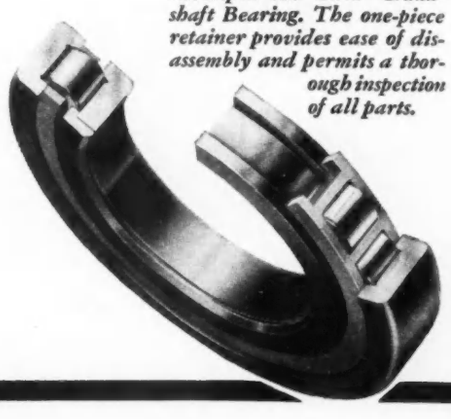


Time is short. In the beginning, we had *years* in which to prepare. Then it was *months* . . . next *weeks.* Now, *seconds* count. Not only must we "Keep 'Em Flying!" but we must keep 'em flying FASTER. That is the objective of every man, woman and machine at SKF. As a result, an endless stream of ball and roller bearings flows from the SKF factory to the insides of warplanes all over America. The time to *waste* time has gone forever. 5065

SKF INDUSTRIES, INC., PHILADELPHIA, PA.

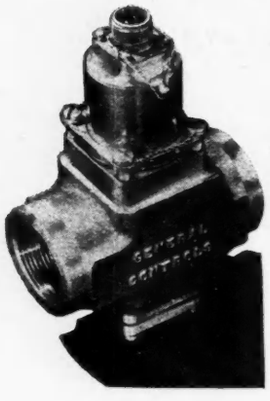
SKF
BEARINGS

• *In cooperation with engine designers, SKF pioneered and developed the SKF Crankshaft Bearing. The one-piece retainer provides ease of disassembly and permits a thorough inspection of all parts.*



GENERAL CONTROLS
AIRCRAFT TYPE
ELECTRIC VALVES

hi-g Trade Mark. *Most important operating characteristic of General Controls Aircraft Type Electric Valves is their positive ability to operate in any position, regardless of vibration, change of motion or acceleration.*

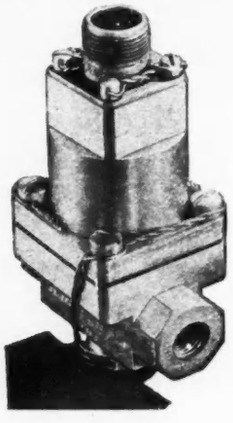


OIL OR GASOLINE SAFETY SHUT-OFF
(TYPE AV-12 AT LEFT)

These valves are of the packless, semi-balanced or single-seated, metal-seated type. Available normally open or normally closed, requiring current only to close or open. No integral control switches. Avoid vapor lock. For intermittent duty only. Operate on D.C.—from 6 to 24 volts. Handle oil and gasoline.

FUEL CONTROL TO CABIN HEATERS
(TYPE AV-1 AT RIGHT)

These valves are of the single-seated, metal-seated, two-wire, current failure type. Weigh from less than ½ lb. up. Handle all vapors, vapor mixes, liquids and gases. Operate on D.C. Available for continuous or intermittent duty. Operation unaffected by vibration, mounting position or acceleration.





NEW BULLETIN. Illustrates and describes complete General Controls AV Series, which include valves for engine priming, gasoline cross feed, oil dilution, fuel and anti-icing fluid control; also high pressure 3-way and 4-way selector valves. Request copy.

GENERAL CONTROLS

PIONEERS AND LEADERS IN THE DEVELOPMENT AND MANUFACTURE OF MAGNETIC VALVES

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Production for Victory

(Continued from page 59)

ing the outside diameter of cylinder barrels by which the thin-walled barrel is water-cooled inside and out during grinding operations to minimize the danger of warping.

Ford, which has undertaken 22 major war contracts, will be producing at an annual rate of $2 billion in 1943, double its peacetime peak.

Buick and Chevrolet divisions of General Motors both are producing another type of Pratt & Whitney radial engine for installation in bombers and cargo carriers. Buick, which was asked to take this assignment in October, 1940, designed a new plant for the purpose and construction began on March 17, 1941. The new factory was operating by December and the first engine was produced Jan. 7, 1942. Only 243 days elapsed between blue prints and the initial engine. Quantity production was reached within a few months.

Rather than build a new plant, Chevrolet converted a former engine manufacturing and branch assembly plant for the production of Pratt & Whitney aircraft engines. The Government contract was received in June, 1941, and the first engine came off the assembly line less than ten months later. Volume output was reached shortly thereafter.

Cadillac began the production of aircraft engine parts for Allison, another GM division, in October, 1939, shortly after World War II began. As Allison stepped up its production to supply the ever increasing demand for the liquid-cooled power plants that are used in four types of U. S. fighter planes, Cadillac was called upon for more and more parts output.

Studebaker Corp. has constructed three new plants in as many cities to manufacture Wright radial engines on a license arrangement. One plant produces aircraft gears, another makes the connecting rods and other precision parts and then final assembly is centered in the third plant. Subcontractors furnish 60 per cent of the parts. The government contract was signed in January, 1941, and output is now on a mass production basis. When capacity production is attained on Studebaker's various war orders, it will be at least two and one-half times that for 1941, thus approaching the $300,000,000 mark.

Chrysler Corp. is building a huge plant that probably will be the largest industrial establishment of its kind in the world for the manufacture of high output Wright-type radial aircraft engines. Construction began June 4, 1942.

Nash Division of Nash-Kelvinator Corp. also is preparing to build high output Pratt & Whitney aircraft engines.

Briggs Mfg. Co., one of the largest body suppliers of the automotive industry, accepted its first aircraft order in August, 1940, when it agreed to make wings for Navy planes. Thus it became the first automotive company to manufacture airframes, shipping wings to an eastern airplane manufacturer in February, 1941.

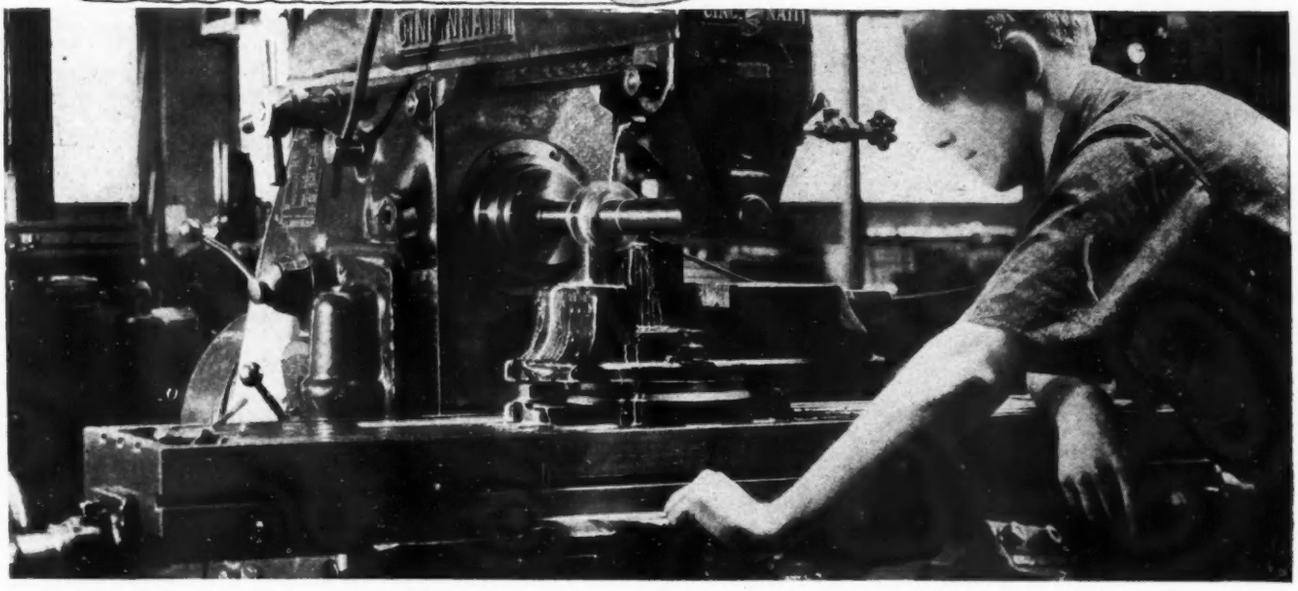
Briggs also is making bomber turrets in a new plant completed May 15, 1942.

Murray Corp. of America, another automotive body builder, received a contract in February, 1941, for the inboard wing sections of an attack bomber. This order required 1964 fixtures compared to only 300 fixtures for an average automobile body. After innumerable design changes, shipments began early in 1942. Murray now is making air-frame sections for several types of planes and also is producing anti-aircraft searchlights and military truck bodies.

Fisher Body Division of General Motors was assigned the task of supplying airframes for B-25 bombers. Arrangements were completed Jan. 21, 1941, and Fisher production men began assembling the 2000 jigs and fixtures needed for the job. Fisher Body is making 55 per cent of the parts, exclusive of the engines and instruments, in the

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There is no obligation for this service. Just drop us a line on your letterhead and ask that a lubrication engineer call. But for your own protection, do it *today*.

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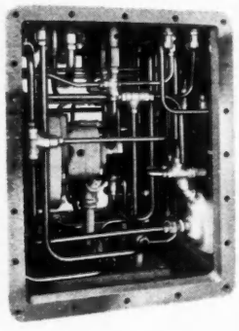
Barnes self-contained hydraulic unit complete with tank, motor, pumps and valves for operating two independent traversing and clamping circuits, and one traverse circuit of wheel spoke forging machine.

Use Unit-Type Hydraulic Structures for New Designs

These self-contained hydraulic units are designed to meet specific machine requirements. They are complete with pumps, pump-controls, valves, and oil reservoir. All piping, except to cylinders, is compact and included in the unit.

Save Design Time...Speed Delivery

Units can be designed and built for control of elements or functions of Milling, Boring, Grinding, Drilling and other metal working machines. They can also be furnished for operations of other types of machines whose functions can be controlled to better advantage hydraulically. *This hydraulic designing can be done simultaneously with your machine designing.* When your machine is ready for assembly you will have a complete hydraulic unit easy to mount, and designed to meet the needs of your machine — piping each machine cylinder constitutes your total hydraulic effort.



Compact Hydraulic piping eliminates unsightly exterior piping. Circuit is complete, and tested for immediate installation.

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FREE New Data: Included in this 40 page book are typical installation circuits, complete data covering piston and gear pumps and complete information covering basic elements of construction and installation of standard units used in these highly successful hydraulic circuits. Write for your copy today. Ask for Bulletin A.I. 1042.



John S. Barnes Corporation

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MAIN OFFICE
AND FACTORY
ROCKFORD, ILL.

completed B-25 plane on a man-hour basis. It is shipping 69 different section types for final assembly. Ten Fisher Body plants are engaged in the project, including a one-time woodworking mill in the South that had been rendered idle when sheet-metal bodies replaced the old wooden-stressed type. This plant has been made the center for subassemblies from other Fisher units.

Chrysler and Hudson lined up with Goodyear to produce the airframe sections for the B-26 bomber to be assembled at another Government-built plant. Chrysler was assigned two sections of the fuselage, Hudson was assigned the third section, with Goodyear supplying the tail assembly and wings.

Hudson began making ailerons for an eastern aircraft builder in February, 1941. When the B-26 order was received in May, 1941, Hudson began applying this technique and experience to making the bomber section it had been assigned.

Ford, which undertook to supply airframes for the B-24 bomber, third of the three types which the automotive industry was called upon to make, received a letter of intent from the government in February, 1941. On April 18, 1941, ground was broken for the new Willow Run bomber plant, designed to become the biggest single manufacturing plant in the world, with millions of square feet of floor area and an adjoining airport one mile square. Differing from the other automotive participants in the bomber program, Ford contracted to make complete planes exclusive of the engines, and also to ship airframe subassemblies to two government-built plants in the Southwest. First machinery was installed at Willow Run in September, 1941, and the production of some parts on a small scale followed the next month. In May, 1942, the first bomber came off the Willow Run assembly line. It was not an all-Ford job but rather a composite plane assembled from some parts made at Willow Run and other parts made by Consolidated Aircraft Corp., at San Diego, Cal. It was an educational model intended to try out the jigs, fixtures and assembly line at Willow Run and also to prove the complete interchangeability of parts between Consolidated, designer of the B-24, and Ford.

Nash is building a plant in the south for assembly of giant cargo-carrying flying boats of the Excalibur type. Subassemblies will be shipped from two Nash-Kelvinator plants converted to aircraft manufacture. General Motors formed a new Eastern Aircraft Division Jan. 21, 1942, for the manufacture of fighter planes for the Navy. Five former automotive plants in the East were grouped for this purpose, with final assembly in a one-time automotive assembly plant.

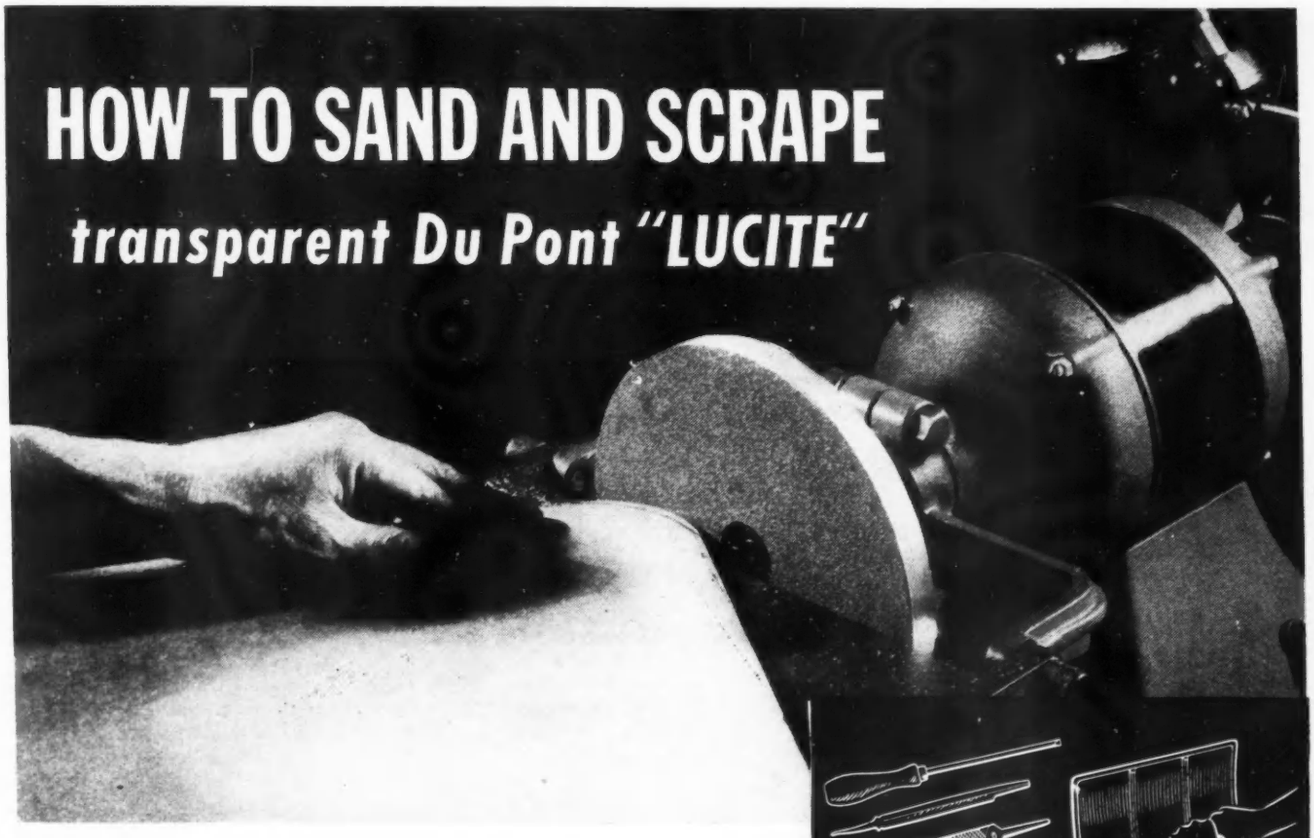
Nash-Kelvinator Corp. has taken over the long unused plant of another automotive manufacturer for the mass production of hydromatic propellers. A contract was signed May 18, 1941, for Nash to turn out Hamilton Standard propellers on a license agreement. By January, 1942, Nash was producing propellers in the renovated factory. Total volume of war orders for Nash-Kelvinator will find the corporation operating at four times its civilian peak.

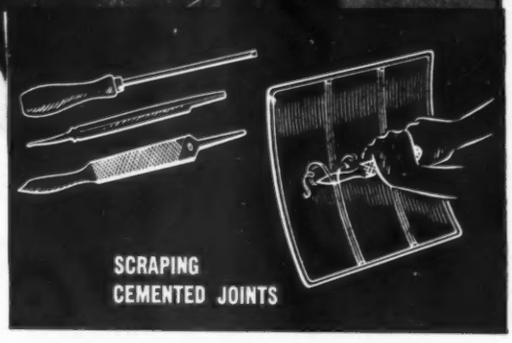
Stewart-Warner Corp., one of the largest producers of automotive parts and accessories, has converted its gasoline automobile heater to military aircraft use, employing it to heat the cabin and to keep the windshield free of moisture and frost.

There are 25,000 individual pieces in a medium tank (28-30 tons). Thirty to 50 per cent of the tank's weight is in armor plate, whose very bulk made it unfamiliar to automotive manufacturing practice. The turret casting alone is as heavy as the average automobile. Fabricating armor plate is more akin to making locomotives or heavy machinery. Nevertheless, the automotive industry has taken on a major share of the tank orders, amounting to 40 per cent of the contracts for the land juggernauts.

Chrysler Corp. was the automotive pace-maker in World War II tank manufacture, signing a contract for medium tanks Aug. 15, 1940, after sending engineers to the Rock Island Arsenal two months previously to study blueprints and then make a wooden mockup. Ground was broken for a huge new tank arsenal Sept. 11, 1940, and the building

HOW TO SAND AND SCRAPE
transparent Du Pont "LUCITE"





SCRAPING CEMENTED JOINTS

Information for aircraft manufacturers and enclosure suppliers

SANDING is used to bring sections of "Lucite" methyl methacrylate resin to close dimensions after cutting or to repair surface damage which may have occurred during previous fabrication. Practically all types of sanding equipment have been successful—stationary and portable belt sanders, reciprocators or vibrators, discs and flexible-shaft operated drum sanders, even hand sanding.

Air-driven grinders and small electric hand grinders are useful for small areas of large pieces that are awkward to manipulate around a fixed machine. Drum sanders are most suitable for curved edges, and belt and vibrating sanders for surface sanding. Discs sanders are good for removing material from straight edges and outside curves.

WHAT ABRASIVES? It is usually safe to select an abrasive just fine enough to remove scratches left by the previous operation. Hand sanding requires finer grades and a larger number of intermediate grades than machine sanding.

TECHNIQUE OF SANDING. Abrasive wheels, discs, drums and belts give best results at about 3,000 f.p.m. Wet sanding is preferable to dry, because a water spray or stream on the work • reduces frictional heat, settles dust, eliminates loading of abrasives, raises speed of cutting and increases wheel life, especially in the case of fine abrasives. Overheating is particularly dangerous because "Lucite" is a thermoplastic. Its surface will become soft and gummy if abrasive action is too severe.

Surface sanding should be applied lightly over an area wide enough to avoid a sink or depression. However, the area to be sanded should not be unduly large as this will necessitate polishing too large an expanse. Jigs promote accuracy when sanding edges to specific dimensions.

NOTES ON SCRAPING

Sanding is preferable to scraping wherever possible. Because, however, narrow areas and intricate contours are difficult to sand, scraping is often necessary.

Experience will determine the type of scraper to use. Scraping tools should usually be ground to the contour of the area that is to be scraped.

Practically all leading airplane plants are using "Lucite" in their airplane enclosures because of clarity, weather-resistance, light weight and strength. Du Pont also manufactures "Plastacele" cellulose acetate transparent sheeting for light plane, glider and trainer enclosures. E. I. du Pont de Nemours & Co., Incorporated. Plastics Department, Arlington, New Jersey . . . and 5801 South Broadway, Los Angeles, California.

DU PONT "LUCITE"
REG. U. S. PAT. OFF.
METHYL METHACRYLATE RESIN

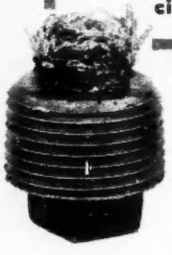


Don't let gears chew themselves to pieces!

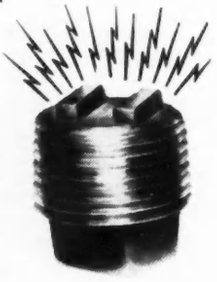


CAPTURING THIS SMALL CHIP MAY PREVENT WRECKING AN ENTIRE TRAIN OF GEARS

A small chip from a gear tooth can cause a major breakdown of valuable equipment if it is allowed to circulate in the gear lubricant.



←This Magnetic Drain Plug is shown with an accumulation of iron and steel particles that were removed from the lubricant in a gear housing.



At high speeds or under heavy loads, the finest gears will show some wear, and chipping may occur. The iron and steel abrasive thus produced constitutes a real hazard, not only to the gears, but to the bearings in the assembly. To stop this destructive cycle, drain plugs in gear and bearing housings should be replaced with Magnetic Plugs. Their powerful, permanent magnets remove metal chips and cuttings before any serious damage occurs.

Let us send you interesting application data showing how Magnetic Drain Plugs will fit into your plans for better peacetime products of the future, or your present war production.

LISLE CORPORATION, Box 1001 Clarinda, Iowa

Magnetic DRAIN PLUGS

was completed April 7, 1941. The first pilot tank came off the line April 12, 1941, and volume production of the medium tanks was under way by August, 1941. An order to triple the capacity of the tank arsenal was received in January, 1942, and construction on a big addition soon was under way. To facilitate the larger output, the production of parts was spread among 11 other Chrysler plants, with final assembly at the arsenal on six assembly lines. A changeover from the riveted M-3 model to the all-welded M-4 was accomplished in July and August of 1942, with no slowing up in production while the model change was in progress.

Fisher Body and Ford were asked to manufacture tanks in September, 1941, Fisher Body receiving a letter of intent Nov. 4, 1941. Fisher Body took over some former automotive facilities for making tank parts and began building a new plant nearby for final assembly.

Ford converted former automobile factories to its tank production job, machining parts in one plant and laying out final assembly lines in another factory not far away.

Various types of power plants are being used in the tanks that the automotive industry is building—aircraft radial engines, twin diesels, V-type liquid-cooled engines and a multi-bank variety composed of a group of automobile engines. Continental Motors Corp. is one of the largest manufacturers of tank engines, making the aircraft radial type.

Chrysler Corp. was given a letter of intent to make the Bofors 40 mm. anti-aircraft gun Feb. 1, 1941. The drawings of this Swedish-designed gun were changed to U. S. specifications and the first gun was completed less than five months later, June 27, 1941. Chrysler engineers reduced machining and assembly time on more than 100 of the gun's 500 parts. Interchangeable parts are being made in 11 Chrysler plants, with final assembly in an old Dodge plant that manufactured army trucks in the last war.

When the aircraft menace to merchant ships operating in war zones became acute, Pontiac Motor Division of GM was asked to make the 20 mm. Oerlikon anti-aircraft gun, a Swiss-designed weapon that is the scourge of dive bombers. An old warehouse, once an automobile engine plant, was cleared out and a pilot line for the gun manufacture was installed. The first gun was completed in August, 1941, seven months after receipt of the order, and volume production was underway within 160 days. British manufacturers took 9½ months to put this gun into production and the Swiss required 11 months. It was not an easy gun to make. One hundred and seventy-pound steel forgings had to be reduced into 41-pound breech casings. And six-pound spring cases were machined out of 56-pound steel blocks.

Hudson Motor Car Co. also is manufacturing the Oerlikon gun in the huge Naval Ordnance Arsenal that Hudson is operating for the Navy. This vast machine shop, composed of 14 buildings and covering 36 city blocks, was begun March 17, 1941. Less than 8 months later some production had started, and most of the plant was completed by Oct. 28, 1941, when Secretary of the Navy Knox dedicated the facilities. Besides Oerlikon guns, the arsenal produces gun mounts and fire control apparatus and serves as a repair point for naval ordnance. Hudson was producing Oerlikon guns at a rate double the anticipated peak within five months of the assembly of the first gun.

Fisher Body is utilizing three plants in the manufacture of a bigger caliber anti-aircraft gun designed to hit bombers flying at high altitude.

But all the guns being made by the automotive industry are not anti-aircraft weapons. Oldsmobile Division of GM received a letter of intent to make aircraft cannon of a foreign design April 25, 1941. Six months later the first cannon was completed and within a few more months mass production had begun. Oldsmobile makes two other types of guns as well for aircraft and tank use.

International Harvester Co. also was called upon to make an aircraft cannon. The first order was received May 1, 1941. A multi-story automobile warehouse had to be renovated and then completely tooled for the job. Nevertheless, these guns were being produced in quantity 10 months later. International Harvester also is producing gun carriages on

MAHON'S Answer to Labor Shortage . . .
in Industry's *Finishing* Operations



Coordinated finishing systems

Shortage of skilled labor is the most vital problem confronting industry today—a problem that is constantly growing more acute as the demands of our fighting forces absorb additional men.

In the Finishing Departments of many war production plants, Mahon engineers have accomplished some exceptional results toward combating this labor shortage. Increased production with decreased manpower is continually being achieved by the institution of more modern finishing methods —by revision and re-arrangement of plant and production layouts—by replacing obsolete and inefficient machinery with *faster* and *better* equipment.

Your entire FINISHING problem—cleaning, rust-proofing, painting, drying and baking—can be turned over to Mahon's engineering staff with complete confidence. The Mahon organization, backed by years of research and practical experience in this highly specialized field, can be depended upon to do a thorough engineering job in the designing and building of ultra-modern Finishing Equipment. Mahon installations have established remarkable records in boosting production output—with less men—in less time—at less expense.

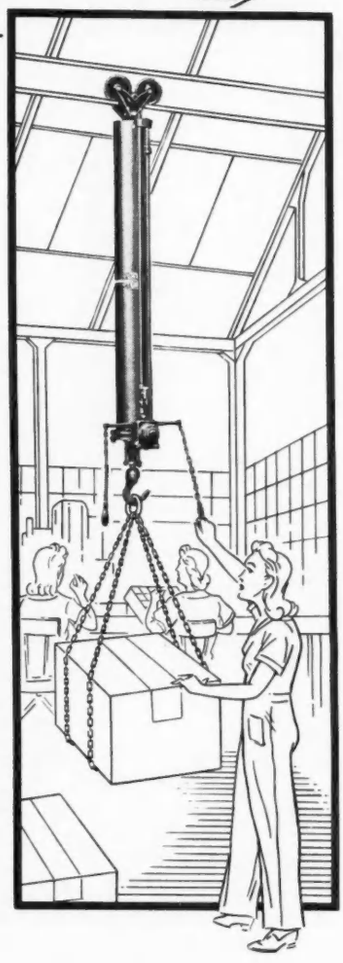
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Reduce Fatigue... Make Lifting Easy WITH CURTIS AIR HOISTS



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Many heavy lifting jobs, formerly requiring male labor, may now be accomplished quickly and easily by women, using Curtis equipment.

Curtis Air Hoists provide these important advantages:

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- Low first cost — lowest operating expense
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- Immunity to abuse or overloads
- One-man or woman operation — finger-tip control
- Do not require skilled labor.

Hundreds of war production plants have increased production efficiency, reduced worker fatigue, saved thousands of man-hours by solving many material hoisting problems with Curtis equipment. Write for full information and free booklet, "How Air Power Is Being Used in Your Industry."

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CURTIS PNEUMATIC MACHINERY DIVISION
of Curtis Manufacturing Company
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• Please send me your free booklet, "How Air Is Being Used in Your Industry," and further details concerning Curtis Air Hoists.

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a former tractor assembly line and serving as a subcontractor on antiaircraft gun parts. The company's 19 plants also are engaged in making such diverse war materials as tanks, aerial torpedoes, shells, fuses and crawler-type tractors.

AC Spark Plug is one of four GM divisions that are a major source of supply for machine guns for the armed forces. This contract was awarded in September, 1940, the first gun was turned out in March, 1941, and mass production was a fact shortly thereafter. The aircraft-type gun contains 311 parts and requires 3000 separate operations, while the gun for field use has 399 parts and takes 3500 operations.

Ammunition to feed the ever-hungry guns of the armed forces is needed by the millions in this war and the automotive plants are helping fill this tremendous demand by making shot, shell cases, shells and fuses. Oldsmobile is one of the largest suppliers of shells for the Army. In the spring of 1940 Oldsmobile began plans to renovate and rebuild a 35-year-old gray iron foundry into a modern forge plant for producing automobile crankshafts, steering knuckles and rods. But an urgent need for shells developed in August, 1940, and Olds converted the place into a shell forging operation instead. Utilizing the upset method, the first shells were produced in December, 1940, and volume output was under way four months later. Oldsmobile's total shell production is measured by millions.

Buick has pioneered in the production of steel shell cases, thus releasing copper that is vitally needed in other phases of the war program. Taking advantage of experience gained in the deep drawing of steel for high stress automotive parts, Buick metallurgists devised drawing and heat treating methods that insured the proper grain flow of the steel and produced the required yield and tensile strength of the casing. Buick is now a volume producer of these shell casings in several calibers.

Willys-Overland Motors, Inc., recently marked the completion of the millionth medium-caliber artillery shell. Willys designed a special 500-ton piercing press for shell production, enabling the first cavity to be made and the hot ingot rounded in a single operation. Shells are only one war product boosting Willy's production rate to four times its recent peactime peak. Chevrolet, Budd Wheel Co., International Harvester and Motor Wheel Corp. also are big producers of shells for Uncle Sam's artillery.

Borg-Warner Corp. metallurgists developed a heat treating method that has made it possible to manufacture clips for automatic rifles by the millions, with a consequent saving in time and material. That is only one of the war products that this corporation is producing in 22 of its divisions. Other armaments being manufactured include transmissions and gears for tank, military truck and marine use; aircraft carburetors, amphibian tanks, gun mounts, armor plate, fuses and shells.

Military cargo trucks have been turned out in quantity ever since 1940 by truck makers like Dodge, which has furnished the armed forces more than 125,000 vehicles; Chevrolet, Yellow Truck & Coach, International Harvester and Studebaker. Designs have been standardized, replacement parts have been simplified and recently wood bodies have been substituted for steel to effect a saving of thousands of tons of material needed more vitally elsewhere in the war program.

When the Army needed armored "half-trac" vehicles in the fall of 1940, three truck companies that had been rivals for 30 years were asked to collaborate on this program. So engineers from White Motor Co., Diamond T Motor Car Co. and the Autocar Co. got together and worked out a standardized design and interchangeable parts to be made by all three companies.

Now Willys and Ford are turning out jeeps by the thousands on automotive assembly lines to fill the needs of U. S. Forces all over the world. So great is the cooperation that Ford furnishes certain parts to Willys.

Specialized vehicles such as tank trucks, mobile machine shops, wreckers, mobile hospital units, field kitchens, ambulances, tank transporters, field telephone units, troop trans

ELASTIC STOP NUTS

...hold tight in action



Here's a glimpse of the Martin B-26 Medium Bomber at work. As with all the fighting airplanes built in the United States and Canada, this fast hard-hitting ship is protected by Elastic Stop Nuts and Self-locking Fittings at thousands of points where vibration and critical stresses make tight fastenings essential.

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ELASTIC STOP NUT CORPORATION • 2339 VAUXHALL ROAD
UNION, NEW JERSEY



Clayborne Engine Stands are designed to speed-up production by making it possible for the mechanic to stand close to the work. Radial or "in-line" engines can be rotated through 360° to the most convenient position. No straining or stretching necessary to apply full pressure when tightening nuts or making delicate adjustments. Increase the value of your "man-hours" by getting out more work in less time by adopting these versatile stands.

"KNOCK-DOWN" FEATURE SAVES VALUABLE SHIPPING SPACE

100% WAR BOND BUYERS SINCE NOVEMBER 1941

Let's Keep Them Flying

Improved demountable construction permits knocking down for shipment. Occupies only about 1/5th the cubical space of erected unit.

Descriptive Literature on Request

MOTOR REBUILDING SPECIALTIES
(Formerly N. F. Clayborne)
2634 S. Michigan Ave. Chicago

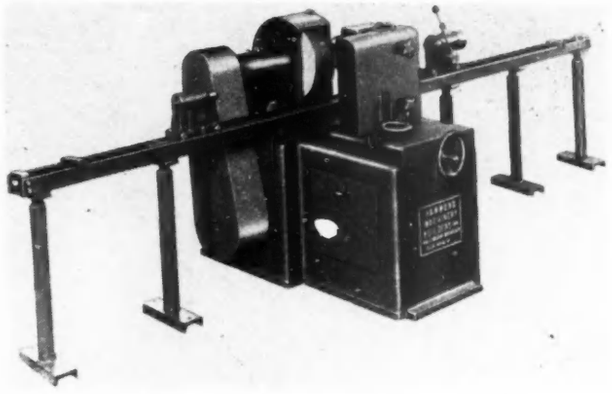
CLAYBORNE
ENGINE STANDS
FOR PRODUCTION
AND MAINTENANCE
USED BY LEADING MOTOR MANUFACTURERS!

ports, artillery prime movers and bomb carriers also are needed by the Army in its diverse operations. Among the producers of such vehicles are Federal, Mack, Reo, Walter and Marmon-Herrington, as well as all the other truck manufacturers mentioned previously.

In 1937 the U. S. Army listed only 11,600 trucks among its equipment. But in 1940 it became operator of the largest truck fleet in the world and before Pearl Harbor military trucks were coming off assembly lines at a rate of 1000 per day. That rate has been considerably increased since then and eventually the number of trucks furnished the U. S. Army and its allies of the United Nations will reach a total equivalent to nearly half the number of trucks registered in the U. S.

Hammond Polisher

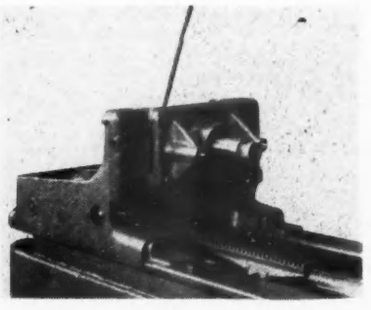
THE accompanying photograph shows the new Hammond OD polisher, produced by Hammond Machinery Builders, Kalamazoo, Mich. It is shown equipped with a special fixture for polishing airplane landing gears. The machine is adapted for buffing and polishing cylindrical shapes of from ¼ in. to 9 in. in diameter. The part to be polished is suspended between the lathe-like heads, which are assembled as a unit on the track, and is moved past the buffing wheel, whereby it is finished from end to end. The handle on the lathe-like head to the right in the photograph serves to release the part suspended between the two heads.



Hammond OD polisher equipped to polish airplane landing gears.

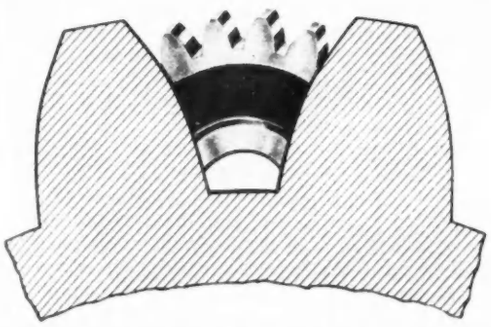
Special Work Holder

LANDIS MACHINE CO., Waynesboro, Pa., has developed a special work-holding fixture for use with its Landmaco machines for threading munitions items. The work is retained on a work-aligning arbor by a collar which fits a square milled close to the end of the arbor. A lever-operated cam arrangement at the rear end of the arbor provides a means for drawing and locking the work piece onto two driving and locating pins. The special work-holding fixture is fastened to a face plate which bolts to the machine carriage in place of the conventional carriage front or vise. It was designed to ensure a closer approach to thread concentricity and to increase production.

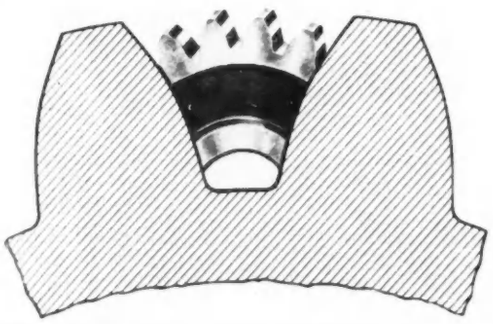


Landis work-holding fixture for use with Landmaco threading machines.

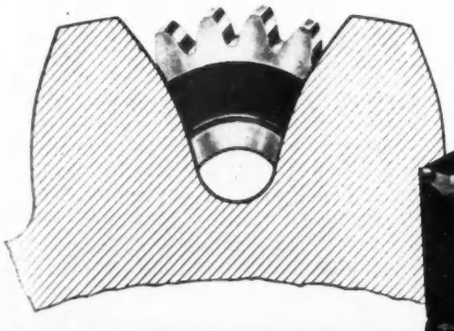
FORMED WHEEL GRINDING CONTROLLED ROOTS ...



STRAIGHT ROOT



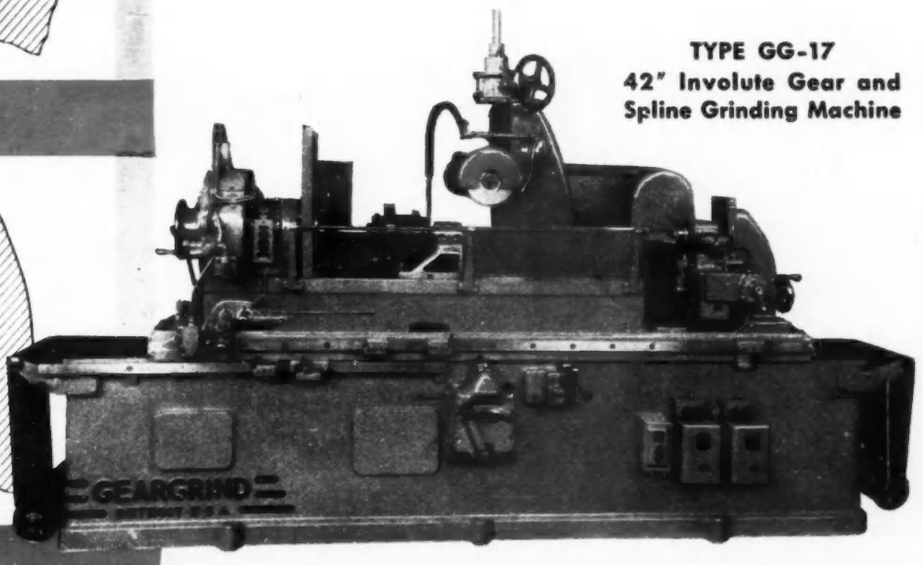
DEFINITE RADIUS FILLETS



FULL RADIUS ROOT

GEARGRIND Formed Wheel Grinders give you definite control of roots—just what your gear design calls for. Full radius roots and definite radius fillets that give absolute line continuity for carrying the greatest possible loads—or plain, straight roots—**GEARGRIND** handles them all.

For external and internal gears, external and internal involute splines, straight splines, serrations and racks, you can count on **GEARGRIND** for *absolute control,* constant production and the finest possible finish. Write today for full information.



TYPE GG-17
42" Involute Gear and Spline Grinding Machine

The GEAR GRIND Inc
MACHINE COMPANY
DETROIT, MICH. U.S.A.

Conversion Almost Complete

(*Continued from page* 55)

25 to 35 per cent, and in some instances, up to 60 per cent. In recent months contract negotiations have re-scaled prices to the extent of saving the taxpayers upwards of $2,000,000. With cumulative orders estimated at $14,000,000 per day, the industry's price cuts average around 15 per cent.

Cooperative Program

Fortunately, the war situation brought about a partnership between the mass-producers of vehicles and the specialists who had devoted themselves to the development of airplanes and airplane engines, albeit on modest levels of production. In the initial stages, the industry acquired the benefit of design and development stemming from years of experience and of vast sums of money expended by people who have devoted all of their energies to air transportation.

Manufacture of airplane engines in mass production brought many new and difficult problems. The basic feature of lightness introduces the machining of intricate parts, long and slender parts which are whittled down from heavy solid forgings, the weight of the finished parts being only 25 to 30 per cent of the original weight. Weight reduction of this order is new in mass production. But when this requirement is coupled with the need for exceedingly fine tolerances on all dimensions, and with finishes measured in wave lengths, the manufacturing problem becomes infinitely more complex.

Straight-line methods, the use of cemented-carbides for cutting steel, advanced gear-cutting procedures, application of surface broaching, multiple rifle drilling, and a host of other advanced techniques have been effective in raising the level of the art to that of mass production.

In the field of airframes and complete airplanes in every category, the activity has overlapped into the province of the passenger-car units. Prominent body builders such as Budd, Murray, Fisher, Briggs, and passenger car units of General Motors and Chrysler Corp. now are contributing vastly to the output of airframes and sections and wings for the assembly plants of the airplane industry. General Motors through its North American organization has assumed a vital role in airplane production. Ford with its Willow Run plant has one of the mightiest establishments for the production of large bombers.

Others are engaged in the manufacture of electrical equipment, landing gear, carburetors, pumps and accessories, brakes and wheels, instruments, etc. As the requirements are stepped up, the parts and accessories producers of the industry have come into the picture to make their contribution as specialists in the art of delivering more for less money.

This picture may be rounded out by noting the manner in which propeller manufacture has been undertaken by the industry, by the creation of new facilities and by the expansion of existing facilities. Witness the work of Lycoming, Continental, Nash, and others. And the new plants of Aeroproducts and American Propeller.

Tanks and Trucks

When it comes to military vehicles—except tanks—the conversion process was quite painless, since their manufacture is closely akin to that of the normal product of the industry. So far as the truck producers are concerned, there was only little change, except for an increase in demand. In the case of companies like Chevrolet, Ford, Studebaker, and Dodge, the shift to military truck production likewise was quite normal. It is interesting to note that Willys was able to shift its entire passenger-car facilities to the manufacture of the "Jeep" whose general characteristics are quite similar to those of the Americar.

This is at least one activity for which the industry was well prepared, because



CAST ALUMINUM FITTINGS

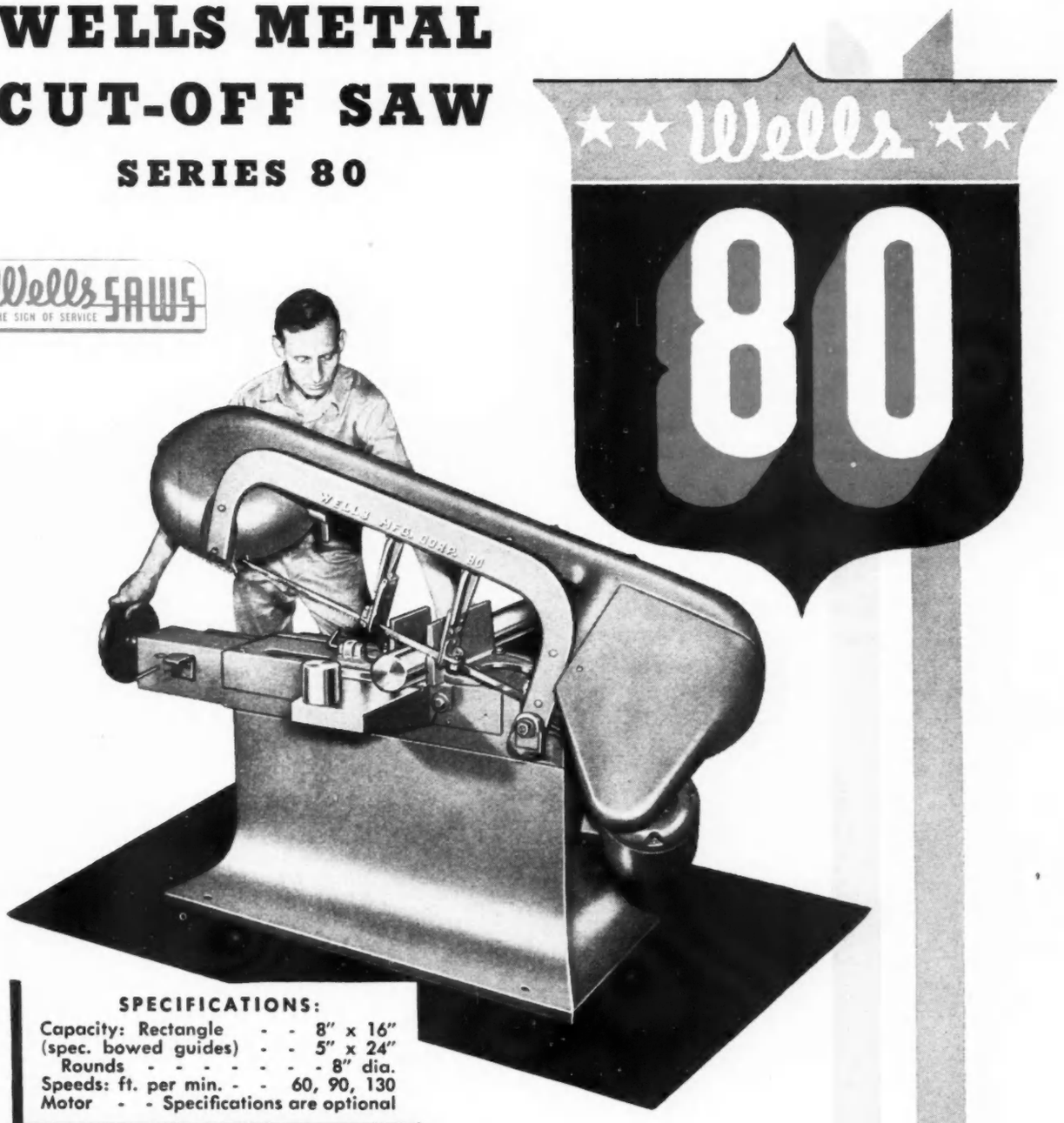
YES! NIBCO fittings of cast aluminum . . . accurately machined to absolute uniformity . . . are moving at ever increasing speed into the aircraft plants where they're needed . . . delivered on time . . . meeting the most rigid standards and the stiffest inspection. The same engineering genius which developed the NIBCO Wrot Fitting formed in one step from a straight tube of copper, is meeting in *outstanding* fashion, the new problems which the war has created. Our facilities are 100% devoted to War work now . . . but when the new day comes . . . you'll need us and we'll need you.

NORTHERN INDIANA BRASS CO.
ELKHART, INDIANA
VALVES AND FITTINGS SINCE 1904

WELLS METAL CUT-OFF SAW

SERIES 80

Wells SAWS
THE SIGN OF SERVICE



SPECIFICATIONS:

Capacity: Rectangle - -	8" x 16"
(spec. bowed guides) - -	5" x 24"
Rounds - - - - - - - -	8" dia.
Speeds: ft. per min. - -	60, 90, 130
Motor - -	Specifications are optional

Not a new Cut-Off Saw, but an improved one — a Cut-Off Saw which embodies all the worth while improvements and features a metal cutting saw should possess.

For sixteen years Wells has been occupied with the task of building better saws and here is the latest design — an accurate, durable and economical continuous cutting machine tool.

Base or legs optional.

Write today for full information and specifications.

Wells Has Established Leadership

WELLS MANUFACTURING CORPORATION • *Three Rivers, Michigan*

Wells METAL CUTTING BAND SAWS

of its close contacts with Army Ordnance. Organizations such as Timken, Spicer, Eaton Axle, and Clark Equipment have worked with the Army since the time of World War I. They were all well prepared to convert quickly for the production of axles, transmissions, drives, joints, etc., for the motor truck manufacturers.

Parts producers, in general, have shifted readily to the making of parts and units for military vehicles. However, the volume of production is so much less than is required in the peacetime output of passenger cars that it has been possible for them to undertake a variety of other manufacturing activities, including munitions making.

Most spectacular of the ordnance tasks undertaken by the industry is the production of tanks. The Detroit Tank Arsenal was one of the show spots of the industry when the production of the M-3 tank was begun. Chrysler recently scored another triumph in the speedy conversion of equipment and assembly procedures incident to the introduction of the M-4 tank of welded construction.

More recently our tank building facilities have been greatly enhanced by the commissioning of the new Fisher tank arsenal, which draws upon Buick and Cadillac for its parts. Among other prominent names in the tank program are International Harvester and American Car & Foundry Co. There are others, of course, whose names are not normally associated with the industry group.

On Ordnance

Oerlikon guns, Bofors guns, cannon, machine guns, bullets, shells and cartridge cases—these are only a few of the items being made in the plants of the industry. For the most part the "know-how" of making them has been based upon job-lot experience. Peace-time production of many of these items was almost on an experimental scale, the methods and equipment used dating back to World War I.

It was necessary to develop mass-production techniques for the fabrication of things on which no previous experience was available. Here, too, the problem of an enormous reduction in the mass of the raw forgings was encountered, the weight of the finished part being only a small fraction of the initial weight.

Too, it was necessary to develop from scratch a great variety of special machinery, tooling and fixtures, so as to place the manufacture of ordnance on a basis of high productivity. That this has been accomplished in a relatively short space of time is a tribute to the industry and to the ordnance officers who have offered such splendid cooperation.

In other fields, the automotive producers have made equally revolutionary strides in placing the manufacture of shells, cartridge cases, etc., on a mass-production basis. New machining equipment, induction heating furnaces, shot-blasting, cold-nosing, continuous heat treating, unique inspection procedures and instrumentation—these and innumerable other techniques mark the contribution of skilled craftsmen of the industry.

Short Cuts

It is difficult to draw the line between certain elements of production "know-how." But there are a few things that may be labeled as short-cuts—procedures adopted to lower costs, to better quality, and to conserve critical materials.

Several examples were mentioned recently by Pontiac's general manager, Harry J. Klinger, in commenting on the company's Oerlikon-gun program. "A part formerly made from a solid forging and finished all over is now made of heavy steel stampings, like the frame or rear axle of your car, and is finished only where it fits other parts. This change reduced the number of machine operations from 29 to 15, released a third of the machine tools for other vital work, and made a sizable reduction in cost to the government, besides saving some 2500 lb. of steel per month. Another part was originally designed and made from a solid forging of alloy steel. Automobile practice suggested a simpler design made of two

BUY

DEFENSE BONDS AND STAMPS



. . . AND LONGER LASTING AETNA BALL BEARINGS

☆ Remember the wiser you buy the more you help to conserve labor and materials that are indispensable to a nation at war—to *VICTORY!*

Long-lived, dependable AETNA PRODUCTS mean less frequent replacements, increased production and extended machine life. You save for yourself, for your country.

AETNA BALL BEARING MFG. CO.

4600 Schubert Ave., Chicago

Thrust Ball Bearings (Standard and Special) . . . Angular Contact Ball Bearings . . . Roller Bearings (Special) . . . Ball Retainers . . . Hardened and Ground Washers

Mode 30-HO TWO SPINDLE HYDRAULIC FEED INVERTED DRILLING MACHINE

BAKER

High production attained in drilling deep holes as large as 4" in diameter. The Baker construction and inverted principle allows ready removal of chips, conserves drills and permits continuous operation. These features are especially valuable in speed drilling for war production.

AIRCRAFT, LANDING GEAR PARTS

CRANKSHAFTS AND PROPELLER SHAFTS

GUN RECOIL CYLINDERS

Push-button controlled cycle has rapid traverse, automatic feed engagement and automatic trip when proper depth is reached. For rigidity in handling large work, both vertical frame and steel base are of extra heavy, well-ribbed construction. Speed gear box is arranged with pick-off gears for changing spindle speeds. All shafts are mounted on ball bearings and the final drive to spindle is through helical gears. Self contained pump lubricates all gears and bearings.

Let us send you full information to help you in selecting efficient equipment for heavy-duty aircraft and armament work.



ARRANGED FOR CHECKING TWO LANDING GEAR CYLINDERS

BAKER BROTHERS, INC.

TOLEDO, OHIO, U. S. A.

parts welded together. By making the part in this way, a saving of three hours in machining time per part is realized, besides a clear saving of over 25 tons of precious alloy steel per month, and a corresponding decrease in cost."

Buick recently announced a development that combines production short cuts with a major saving of critical materials. Working with a special ordnance industry committee under the direction of Major General L. H. Campbell, chief of Army Ordnance, Buick has cooperated in the perfection of a method of producing shell cases in the larger calibers from steel blanks rather than brass slugs.

The Buick process produces a shell case capable of withstanding the high pressure of gun fire, which is easy to load and easily ejected from the gun chamber. It requires no special steels or alloys needing critical metals, and the shell case may be produced in large quantities to the highest standards of quality. At the same time, it does not present a machinery and equipment problem, the manufacturing process being capable of utilizing much of existing facilities of munitions makers.

Many suggestions for simplifying a job or doing it better come from materials suppliers. Another prolific source of short cuts is in the suggestions made by the men on the machines.



Conservation of Materials

The gravest problem in our war economy is that of raw materials. The supply of critical materials is limited; its distribution to the right place at the proper time is a matter of greatest moment. It is heartening to see that the industry has made great strides, not only in the use of substitute materials, but also in the conservation of all materials.

Consider the case of Arma steel, product of the Saginaw Malleable Iron Div., General Motors Corp. The first military application of Arma steel was in the 50 calibre machine gun, and the first part to be cast was the support barrel. This eliminated the use of steel tubing. Later other parts of the gun were made of Arma steel.

Brown-Lipe-Chapin now makes 21 machine gun parts of Arma steel. Six parts of the Cadillac light tank transmission—oil pump, drive gear, driver idler gear, brake clevis, transmission clutch hub, and brake-band lever—are made of Arma steel. Use of this material promotes conservation of nickel, chromium, and tungsten, by replacing alloy steels of various types.

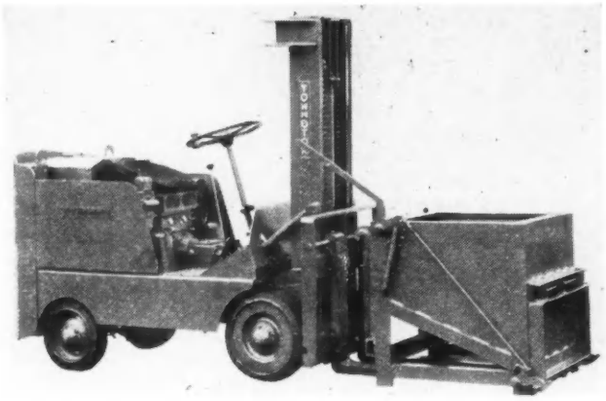
When one of the automotive body specialists undertook to produce giant searchlights for the Army, they went over the design with a fine-tooth comb to adapt it to mass-production methods. The engineers found it expedient to use steel stampings throughout, eliminating the aluminum castings previously used. This resulted in a saving of 700 pounds of aluminum for each searchlight built.

To facilitate field repairs, the steel stampings were made interchangeable with the aluminum castings. The stampings are Bonderized, primed, and painted to resist corrosion.

Ford has made some marvelous strides in the field of metallurgical development. The centrifugal casting process which has been employed by Ford for a number of years in the production of transmission and rear axle gears, has been applied to the making of aircraft-engine parts. For example, the cylinder barrel is centrifugally cast instead of being drop-forged. The casting weighs 37 lb., as compared with 47 lb. for the forging. Moreover, since the forging requires melting of 72 lb. of metal, actually the centrifugal casting method saves about 35 lb. of metal in process.

GM Ignition Booster Coils

Two ignition booster coils for aircraft engines have been introduced by the General Electric Co., one for 12-volt, and the other for 24-volt circuits. The object of these coils is to provide ample spark energy for starting aircraft engines when the magnetos are turning over at low speed; they are cut out of the ignition circuit as soon as the engine has started. One booster coil is required for each magneto.



Towmotor truck fitted with hopper for handling small parts or bulk materials.

load. The photograph shows the hook attachment, which is integral with the rear side of the hopper and by which the hopper is lifted when the fork support bar is lifted under it. The clearance underneath the hopper is ample to permit handling without need for the removal of the standard forks.

The slanting bottom ensures quick and complete emptying. The gate is equipped with a latch which catches automatically when the gate closes by gravity. Opening of the gate for discharge is accomplished by pulling down on the lever which is within easy reach of the driver when the hopper is in the dumping position.

Materials Handling Equipment

(*Continued from page* 96)

engineered for die handling. The equipment is built under the re-inspection service of the Underwriters' Laboratories.

A NEW model of its adjustable-belt utility conveyor has been announced by Lamson Corp., Syracuse, N. Y. It incorporates a number of improvements over a model brought out last year. This new Model CM can be operated in any position from horizontal to an inclination of 35 deg. It is 11 ft. long, has a belt 14 in. wide, and operates at a speed of approximately 60 fpm. The maximum live-load capacity is 100 lbs., or 600 lbs. per min. The drive is by a ⅓-hp, single-phase, 60-cycle, 110-volt geared-head motor with 25 ft. of flexible connecting cord. Means for adjusting the belt tension are provided. The conveyor is provided with swivel-type casters of 6 in. diameter, with two wheel locks. This conveyor is adapted for piling cartons, packages, bags, and boxes. For transportation in warehouses, several can be used in series without cleats.

IN THE accompanying photograph a hopper of 17½ cu. ft. capacity is shown attached to a Towmotor, product of the Towmotor Co., Cleveland, Ohio. The hopper capacity can be changed greatly by making only moderate changes in the linear dimensions. This method is adapted to handling small parts or bulk materials when they are collected from storage bins equipped with chutes, or from production machines which discharge into them. The hoppers provide an easy means of collecting the material at the point of production or processing while the Towmotor is at work handling other hoppers or working at other jobs. When the other hopper is filled, it is moved away by the Towmotor and replaced with an empty hopper, and the filled unit is then towed to its destination.

The hopper is designed to be carried directly on the fork-support bar. This provides a firm carrying position and permits rapid forward tilting of the lifting mechanism when dumping the

MID-WEST REDUCED THIS GUN MAKER'S HONING TIME BY 83 PERCENT!

How Excessive is Your Honing Time?

The X Manufacturing Company, one of the largest gun builders in the United States, ran smack into serious trouble in the honing of their three-inch and five-inch gun barrels. The honing was being done in two operations—roughing and finishing—during which approximately .011" of stock was being removed. The trouble lay in excessive heat being generated within the barrels. The heat was so terrific company engineers had to pour oil on the outside of the barrels throughout the honing operation. Notwithstanding this, the heat caused considerable distortion and many of the barrels had to be straightened and rehoned.

Furthermore, the heat limited the honing machine to a steady run of only 15 minutes, after which the barrels had to cool for two hours before inspectors could star gauge the gun. Average time required to hone a barrel ranged from 4½ to 5 hours.

A Mid-West engineer was invited in. He found the hones the company was using were too hard. They were "loading up," chipping along the edges, generating excessive heat and creating an altogether unsatisfactory finish. Following a few experimental runs with other stones he recommended the MID-WEST 180 52X hone for the rougher and the MID-WEST 500 38X hone for the finisher. These stones were adopted with this result:

✔ THE OIL COOLING TREATMENT HAS BEEN ABANDONED!

✔ INSPECTORS CAN STAR GAUGE IMMEDIATELY AFTER HONING!

✔ THE SURFACE FINISH HAS BEEN GREATLY IMPROVED!

✔ AVERAGE HONING TIME HAS BEEN REDUCED FROM 4½ TO 5 HOURS TO APPROXIMATELY 50 MINUTES PER BARREL!

That is but one instance in which MID-WEST Micro Bond honing stones have helped to save time, material and money and increase production — all vital contributions to our war effort. There are many others. Why not ask our engineers—located in most large cities throughout the United States—to tell you about them? Ask them about Micro Bond, the remarkable new abrasive developed by MID-WEST that has "given a new prod to production." Or, mail in the coupon printed herewith. Let us help YOU with YOUR honing problem.

MID-WEST ABRASIVE COMPANY

Manufacturers of DEPENDABLE Abrasives

1960 E. MILWAUKEE AVENUE

DETROIT, MICHIGAN



Mid-West

★ *Honing Stones*

★ *Superfinishing Stones*

★ *Grinding Wheels*

★ *Emery Cloth*

★ *Sandpaper*

Mid-West Abrasive Company,
1960 E. Milwaukee Avenue,
Detroit, Michigan

Gentlemen: Please send me additional information on Mid-West Micro Bond honing and superfinishing stones.

*Name*_____

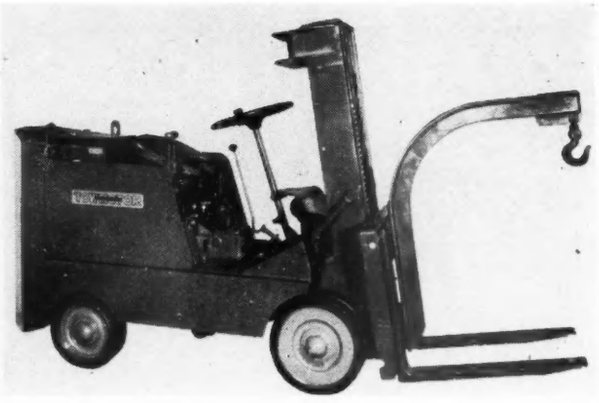
*Company*_____

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*City*_____ *State*_____

Extension crane-type arms may be mounted on the Towmotor in conjunction with standard forks, and they can be used also with the forks removed. Motors, castings, engines, production machinery or machine parts, or any type of container which is ordinarily handled on crane hooks, can be readily moved by the use of this attachment.

In many cases it is necessary for the fork-type truck to handle skids or pallets of very different dimensions. It is therefore desirable to use more than one length of fork. Fork-extension adapters are then used, by means of which fork lengths can be changed almost instantaneously.



Towmotor equipped with extension crane-type arms.

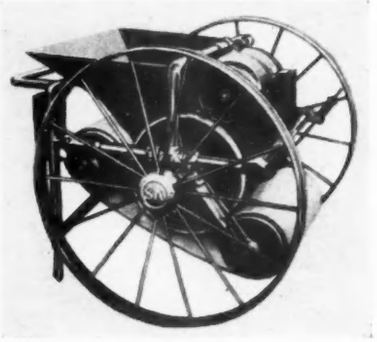


SPEED UP production with a Wayne Tube Beader. It converts a difficult manual job requiring skilled men into a simple mechanized process handled easily by inexperienced girls. Makes perfect beads or flares, any type and any distance from end. No weakening or roughing of tubes. Machine is small, compact and will pay big returns on a small investment. It releases five skilled mechanics for other work. Write at once for descriptive folder and prices.

Breaks Another **BOTTLE-NECK!**

THE WAYNE PUMP COMPANY
FORT WAYNE, INDIANA

THE S-A box-car loader, a product of the Stephens-Adamson Mfg. Co., Aurora, Ill., in addition to being used for box-car loading, has been used also for throwing material into the holds of ships, which required a special arrangement of the thrower unit. The unit is suspended from a long spout



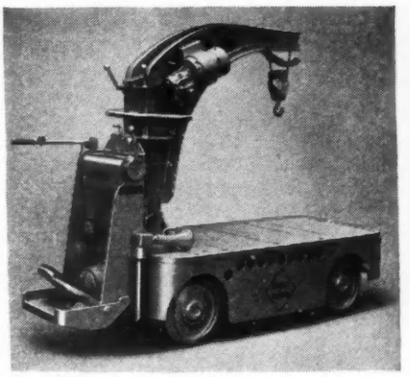
Stephens-Adamson box car loader

which can be turned by remote control from a panel on the deck of the boat. By throwing material into the corners of the hold, dangerous hand-trimming is eliminated, and the load can be spread quickly and evenly.

A NEW power industrial transportation unit built by the Elwell-Parker Electric Co., Cleveland, Ohio, performs the functions of a load carrier, a crane, and a tractor. As a load carrier, the mobile unit has an unobstructed platform 84 in. long by 40 in. wide by 25 in. high, with a rated capacity of 6000 lb. As a crane handling up to 2000 lb. at 42 in. on the boom, it lifts and transports castings or other heavy, bulky objects. As a tractor, it first loads the trailers by means of its own crane, then hauls them at speeds up to 5 mph.

This truck has two-wheel drive and four-wheel steer. The frame is made of heavy-section formed plates welded into a one-piece structural unit embodying the control dash. The boom is of heavy formed channel members, reinforced with tie rods, lattice bars, and gusset plates, and slews around a 3½

in.-diameter alloy-steel pillar. Thrust load is taken on ball bearings at the base of the column; radial load, on roller bearings at both top and bottom. Other features of the truck include widely-spread stabilizing coil springs; equal-length, full-floating drive shafts, and heavy-duty motors.



Elwell-Parker combination crane and load-carrying truck.

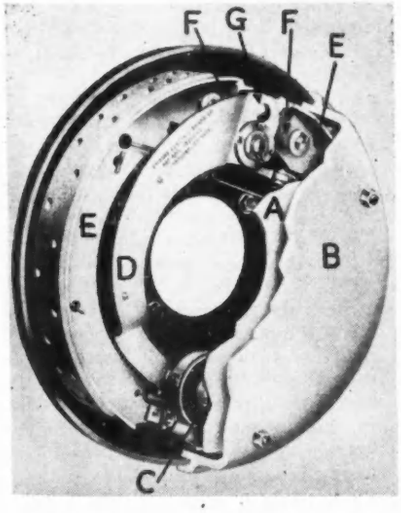
Magnetically Actuated Brake

EMPIRE ELECTRIC BRAKE CO., Newark, N. J., manufactures a magnetically-actuated brake for motor vehicles and trailers, known as the Magdraulic brake. It comprises a brake backing plate, a brake-shoe mechanism, a lever, an electro-magnet, and an armature core, all housed within the brake drum.

The armature disc A, which is a circular flat steel plate, is secured to the brake drum B and rotates with it. The electro-magnet C is supported on the end of lever D and is always in light contact with the armature plate. The lever is pivoted at a point between the ends of the brake shoes E. Brake shoe links F bearing against the lever pin G open the brake shoe and apply the brake when the lever is moved in either direction.

When the controller is depressed either by a pedal or lever, an electric current flows from the storage battery or generator through the electro-magnet. The attraction and friction of the facing of the electro-magnet on the armature disc causes the lever to move in the direction of rotation of the wheel in which the armature disc is turning. Frictional force at the end of the lever multiplied by the lever ratio causes the lever pin, fixed to the pivoted lever, to expand the brake shoe by moving the shoe link, thus exerting a retarding effect. This retarding effect exerted by the brake shoes is proportional to the flow of current through the electro-magnet, and the current varies in direct proportion to the movement of the controller resistance unit.

The brake controller comprises a resistance unit closely wound with wire with which contacts a phosphor-bronze brush. The latter is moved over the length of the resistance winding, thereby varying the current flowing through the winding and brush to the brake mechanism. There are between 40 and 50 steps between the "Full On" and "Off" positions of the control mechanism. These control units can be furnished in different designs to give more or less gradual application of the braking power.



Magdraulic electric brake for motor vehicles and trailers.

What's New IN METAL PARTS WASHERS



THIS BOOK IS YOURS FOR THE ASKING

Just off the press . . . an interesting, informative book on Detrex Metal Parts Washers. Illustrated and described is the metal cleaning equipment now in use for many phases of War Production. Indicated is the trend toward the metal parts washers of the future.

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Tooling Up for Victory

(*Continued from page* 91)

The second consists of individually-built, special-purpose machines, each designed to do one particular job in the war-production program.

Now let us consider the multi-purpose machines. In this group, stepping up production required not making "more and more of the same" but cutting down on the number of models in order to be able to make more of each of the models retained. The production principles behind this move were, of course, exactly the same as those well understood in the automotive industry.

Reducing the number of models made it possible to schedule the remaining models in larger lots. This in turn made possible the breaking down of operations into simpler steps, and the use of men less skilled than those ordinarily employed in machine-tool building.

The result is that in machine-tool plants where general-purpose machines are built, we are for the first time approaching, although still on a small scale, some of the straight-line production methods used in the automotive industries.

Now, in machine-tool plants where special-purpose machines are built, exactly the reverse has been the case.

In these plants increased output has meant a tremendous expansion in the engineering department and the building of many types of machines which are new in industrial history.

These special-purpose machines have been needed in two circumstances:

First—in cases where enormous volume of one particular part made it practicable to build a special automatic machine capable of turning out that part in tremendous quantities:

Second—in cases where the work to be done had no counterpart in peacetime production, and therefore demanded the invention, design and building of a new type of tool.

The production of Garand rifles is a good example of both these circumstances. Before the threat of war developed, Garand-rifle production was essentially a small- or average-lot operation. But with Garands needed by the hundreds of thousands, the government's armory at Springfield, Mass., had to be tremendously expanded, and its entire rifle production converted to mass-production, special-purpose machinery. Scores of new machine tools had to be specially designed and built from the ground up, for the continuous, repetitive production of one particular rifle part. And in some cases, such as in the reaming of the barrels, entirely new tools, which had no counterpart in peacetime production, had to be designed and built.

Machine Tools and Aircraft Production

But it is in connection with the aircraft industry that most of today's extraordinary special-purpose machines have been developed.

In fact, in many respects the machine tool industry and the aircraft industry show a surprising parallel.

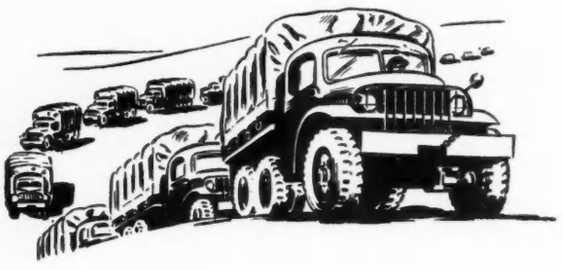
Both received the impact of war somewhat earlier than did most other industries. Both began rapid expansion well in advance of the National Defense Program and had surprising accomplishments to their credit by the time war was actually declared against Germany and Japan. And both were completely converted to war production before most other industries had to make the change-over.

There is an interesting connection, too, between the machine tool and the aircraft industries in the all-important consideration of accuracy.

Even the best operator can get out of a machine tool only the degree of accuracy that has been built into it.

Since in aircraft production, tolerances are frequently extremely narrow, it was imperative that the machine-tool industry build machine tools capable of meeting these exacting requirements.

Years ago it was the automobile industry that gave the machine-tool in-



Supply Trains Roll with the Help of ACP Products and Processes

Automotive manufacturers who have converted for war know the help they can get from ACP Products and Processes . . . Chemicals and their applications which grew with and contributed so much to the mass production of American automobiles.

DEOXIDINE, the acid cleaner which made mass production of all-steel auto bodies possible, is doing its war-time job on the Army's prime movers . . . preparing steel perfectly for painting, eradicating rust and neutralizing rust-producers.

KEMICK holds to and protects metal surfaces even when heated to redness . . . has been used all over the world on exhaust manifolds.

FLOSOL wets oily surfaces, is an exceptional soldering flux for steel, brass, copper, tin, terne plate and zinc.

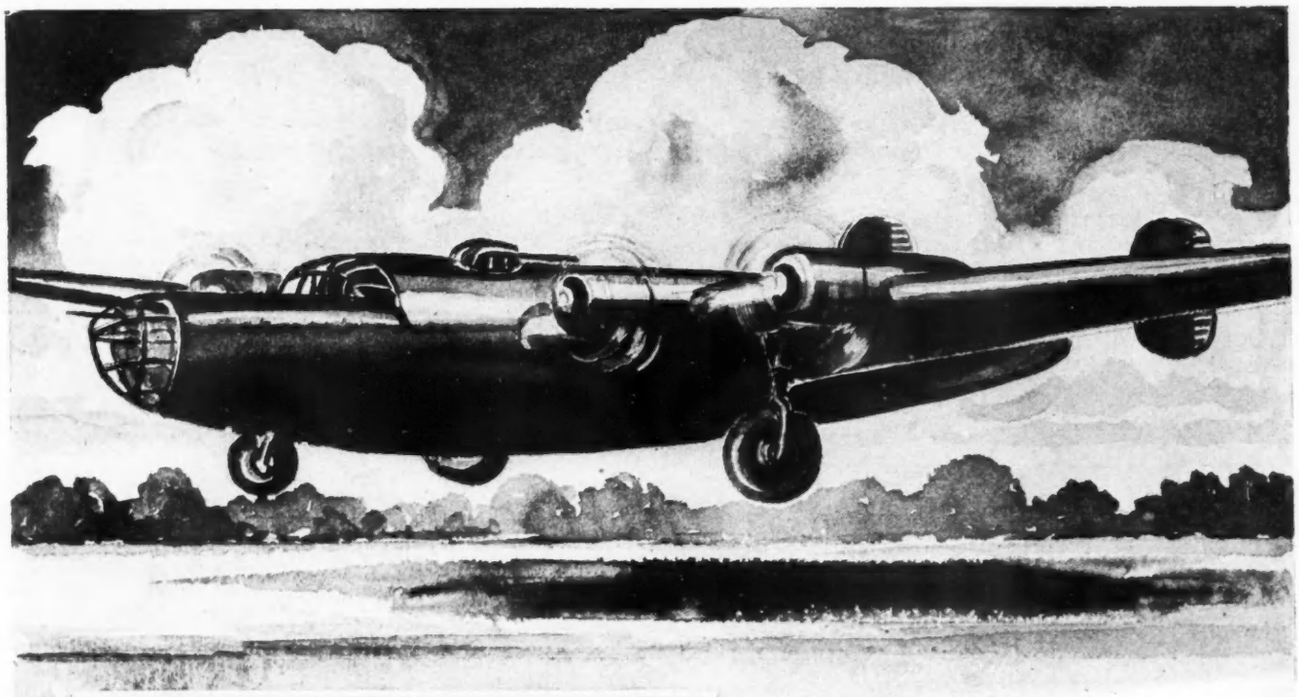
These three are typical of the many ACP Products and Processes, well known in peacetime, that are serving in the war effort.

•

Others include: RODINE, the pickling inhibitor that saves steel and acid, prevents pitting and embrittlement; CUPRODINE that provides a dense, bright copper coating on steel by simple immersion; LITHOFORM for coating galvanized iron before painting to prevent peeling and scaling.

These are typical ACP Products. The experience of the ACP laboratories in metal treating and finishing processes is at your service.

AMERICAN CHEMICAL PAINT CO.
MAIN OFFICE AND WORKS
AMBLER · · · PENNA.
ACP
CHEMICALS ACP PROCESSES
DETROIT, MICH., 6335 Palmer Ave., E.
CANADIAN BRANCH
WALKERVILLE · · · ONT



RBC

NEEDLE BEARINGS

help set them down in safety

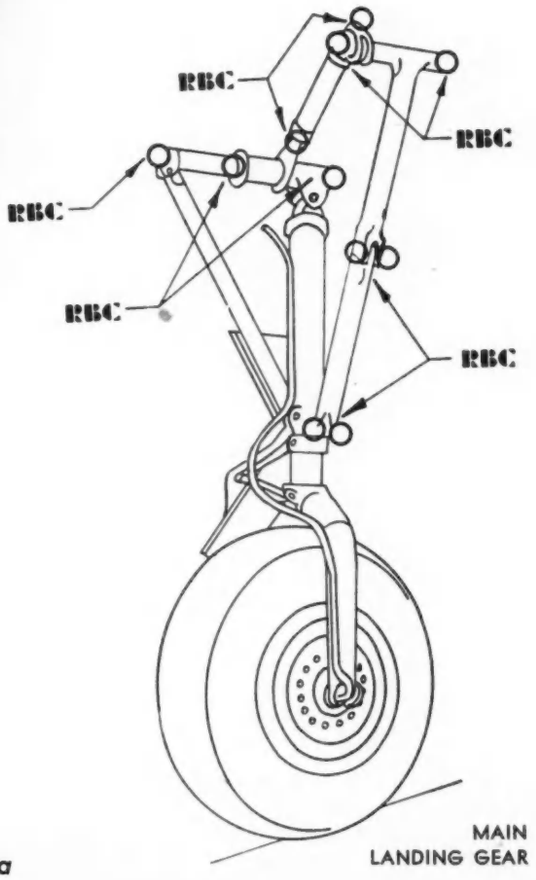
Landing gear on many of our fighters and bombers are RBC equipped to bring them home to roost—and fly again on other missions at a moment's notice.

RBC engineers, working in collaboration with aircraft engineers over a period of years, have developed these bearings to provide the utmost static capacity; minimum overall dimensions and weight; ease of application; minimum maintenance.

Also used on

BOMB BAY DOOR MECHANISMS
WING FLAPS—CONTROL PULLEYS—GEAR PUMPS
CONTROL COLUMNS—STEERING CYLINDERS

Send for Catalog with Complete Engineering Data



MAIN
LANDING GEAR

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TRENTON . . . . NEW JERSEY

dustry the impetus to move sweepingly ahead in the design of special-purpose equipment. Now it was the aircraft industry that gave it the impetus to develop ultra-precision equipment.

It is my firm conviction that, working together, the machine tool and aircraft industries have now raised the level of production performance throughout the entire industrial field. This factor may prove of extraordinary importance in the competition for world trade in the post-war period.

But today is no time to talk about what may happen after the war. Today, the machine-tool industry, the automotive industry, and the aircraft industry are engaged in a triple partnership dedicated to the sole purpose of winning this war.

Our three industries constitute a major sector of the production front—and together we will carry this front through to victory.

The Automotive Industry at War

(*Continued from page* 51)

Annual National Automobile Show.

Meanwhile, a wave of strikes had hit the country during this period, including many in automotive plants. At one time, 18 defense plants in the U. S. were halted.

Throughout the summer of 1941, labor disputes continued to hamper the nation's defense efforts. In August, the War Department declared that 30 strikes were impeding arms production.

The declaration of war on Russia by Germany in June, 1941, was the signal for the United States to considerably step up its contract allotments. In the automotive industry, contract after contract was doubled and some even tripled. By the end of the month, total orders had reached $2,604,400,000.

With this increased participation, the Office of Production Management ordered an immediate 26½ per cent cut in passenger car output. Industry leaders willingly accepted the order, but continued to solicit more defense contracts. One company declared that it could easily handle twice its alloted war work.

Meanwhile the situation in the Pacific was growing tense. While defense orders were increased and new contracts let, later events were to prove that it was far too little. When the attack by the Japanese came, total orders held by the motor car industry amounted to $4,800,000,000.

In little more than a month, total orders had jumped to $10,000,000,000, or more than double the amount of all defense contracts given the industry in the first two years after the Nazi invasion of Poland. Orders have continued to grow until today, the accumulated total is $15,000,000,000.

The magnitude of the task can be seen in the fact that 986 automotive plants in 31 States are actively engaged in producing 223 war items, ranging from four-motored bombers to the microscopically small ball bearings used in aircraft instruments.

Of the major products, the automotive industry is slated to build 75 per cent of all aircraft engines, over one-third of the machine guns, more than two-fifths of the tanks and tank parts, more than half the Diesel engines, 100 per cent of the motorized units and many other items of military equipment.

It will always stand to the credit of the automotive industry and of American enterprise, that no education was required to effect the transition, and that no time was lost in putting the new way into effect. Thus it was that the Automotive Council for War Production came into being. In a few hours after Pearl Harbor these men, who proudly pointed to their fierce competition as one of the principal reasons for the rapid growth of the automotive industry in a mere span of 40 years, were meeting around conference tables, map-



Bob and Dewey Rutlidge help build the FULLER Transmissions that are going into America's military vehicles. They are not engineers—not designers—just two of the many splendid FULLER employees. Hitler would say they are just a couple of working men.

So they are, Adolph. But not the kind of working men you know. You think Americans are soft? You should feel these boys' muscles. You think Americans can be herded like your ignorant Nazis? You should try ordering these boys around. You think Americans won't work to keep you from dictating to us? You should see these boys working 12 or 14 hours hours a day, turning out equipment to beat you!

Bob and Dewey started working here about the same time, 14 years ago. Bob, the one with the cap, is service repair foreman now. His brother, Dewey, is final inspector. Both of them know every nut, gear, and bearing in a transmission. When they O.K. a unit, it's ready for service!

Just a couple of workmen, you say, Mr. Hitler? That's right! Just two out of millions like them that we have over here. Just two good reasons why you and your goose-stepping Nazis never can win!

FULLER MFG. CO. Kalamazoo, Mich.



Part of a task force boards a nine-place glider. Many makes of these new craft are being fabricated with Boots Self-Locking Nuts.

They arrive, all set to take over. This is the way glider troops will soon be carrying out assignments on many fronts.

Glider Assignment

The entire line of Boots Self-Locking Nuts is carrying out an important assignment with spectacular effectiveness in the rapidly expanding glider industry.

This is particularly true of the Boots "Cage" Nut. Specially devised for use in building planes of plywood and plastics, this recent addition to the Boots family has proved itself indispensable in attaching glider fillets and fairings, in mounting instruments to dashboards, and in many other applications requiring a positive self-locking device. The "Cage" Nut combines the familiar Boots all-metal Wing Style Nut with a special base designed to be clinched permanently into the plywood. Applying it is a *one man* operation, as it can be clinched in from *one side.* Its grip is so firm that it withstands—without tearing the plywood—the torque of bolt or screw insertion when applied by production methods.

In short, the "Cage" Nut is making possible increased substitution of plywood for vital aluminum on many aircraft applications. Remember, Boots Nuts "Outlast the Plane." Send for new catalogue today.

General Offices
New Canaan, Conn.

BOOTS

AIRCRAFT NUT CORPORATION



The Boots "Cage" Nut, ready to fasten plywood sub-assemblies for faster production.



The special tool for fastening the "Cage" Nut to the plywood.



When applied, the "Cage" Nut grips the base sheet of plywood permanently. Now it is ready to be bolted to adjacent part of the plane.

ping out ways to overcome mutual problems.

The Council was set up as a voluntary organization to intensify cooperation between manufacturers of motor vehicles, bodies, trailers, parts and accessories, and tools and dies. Today, and for many months, this group has been comparing notes on each other's war assignment, pooling technical secrets, exchanging machine tools and tooling facilities, facilitating sub-contracting and working out production shortcuts.

Among the reasons set forth by the architects of the cooperative plan, was the recognition of "the obvious dependence of this nation and its allies upon the automotive industries of the United States for the main production push."

Early in the year, when conversion of equipment was the major problem, the Council's Machine Tool and Equipment Service and Tooling Information Service carried the main loads. Through the first, all of the industry's available machinery was inventoried, and nearly 9000 machine tools, presses, welders and other pieces of production equipment have been taken from automotive plants and scattered throughout the nation.

In the first six months, the Council listed almost a quarter of a million machines in 442 plants of 259 companies. They represented the equipment of motor vehicle manufacturers, parts and equipment manufacturers and tool and die shops. Of these machines, 66 per cent are now fully at work on production for victory. Some are allocated to war contracts, a few are working on replacement parts while others are available for sale or lease, or for production in their present location.

A recent addition to the activities of the War Products Division is a bulletin, "Production Information," which will be distributed to a select group of production experts in the industry. This will cover a wider range of companies than was previously possible at the committee meetings of the various divisions.

When automotive companies are confronted with technical problems that are not solved over the conference table, they are turned over to the War Engineering Board of the Society of Automotive Engineers, where the best engineering talents of the United States are focused upon them.

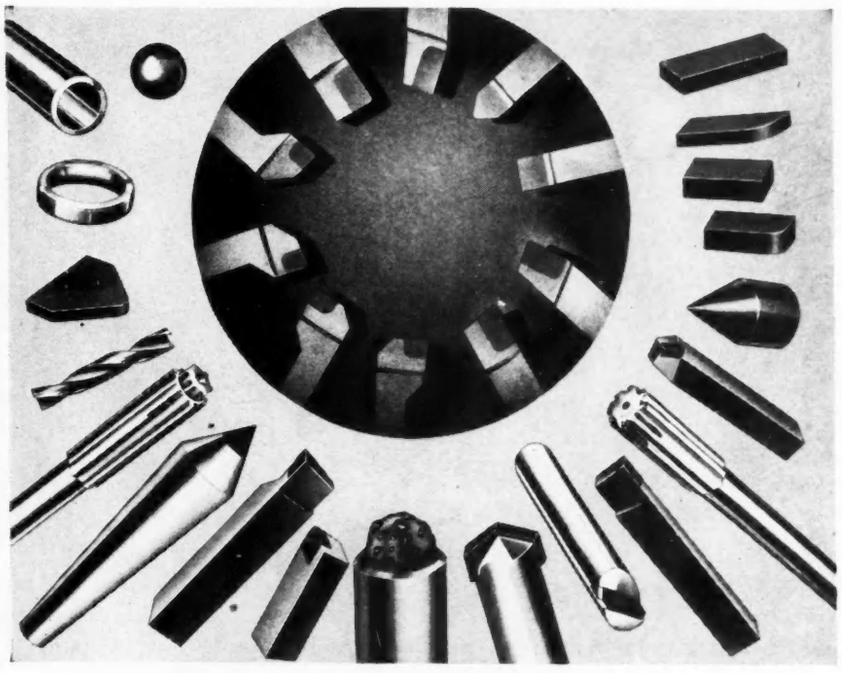
Working with research staffs of the steel industry and with Army Ordnance engineers, the War Engineering Board has established standards for emergency steels to replace kinds of steel which can no longer be manufactured because of scarcities of alloying metals.

There are many hundreds of examples which might be cited to show how productive ingenuity is being pooled for victory by the automotive engineers at war. They are indications that, under duress of national danger, the voluntary form of cooperation which free and individualistic Americans prefer is still capable of becoming a powerful force in opposition to the regimented power of enforced cooperation upon which the rulers of slave nations build their hopes of conquest.

Today, in Detroit or in any of the hundreds of industrial communities which have been linked into Detroit's assembly lines, the operator of an alley machine shop has at his command, through the Automotive Council for War Production, the full force of the nation's best minds in the fields of industrial research and the most highly skilled hands in the hundreds of big and little shops which constituted the automobile industry until the attack of the Axis nations threw them together.

Is this pooling of the industry's "know-how," resources, and experience giving our armed forces war equipment? Will we meet President Roosevelt's production goals? The answer lies in the record to date:

On assignment after assignment, the automotive industry is ahead of schedule. Each day, former motor car plants are sending $14,000,000 worth of war equipment to the armed forces. Barring factors beyond its control, the industry will be producing by year-end war goods at an annual rate of $8,000,000. What seemed impossible only a few months ago is now virtually a reality.



ANNOUNCING—NEW, STOCK-TOOLS AND BLANKS *plus* NEW, TIME-SAVING STANDARDIZED DESIGNS!

Carboloy Company now makes available (effective Sept. 8) a large number of additional *STANDARDIZED* tools and blanks, to supplement its present standard boring, facing and turning line.

These newly standardized tools and blanks fall into two classifications as follows:

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A new 28-page general tool catalog, No. GT-142, contains complete prices and specifications. Copies on request. *Send for Free Catalog NOW!*

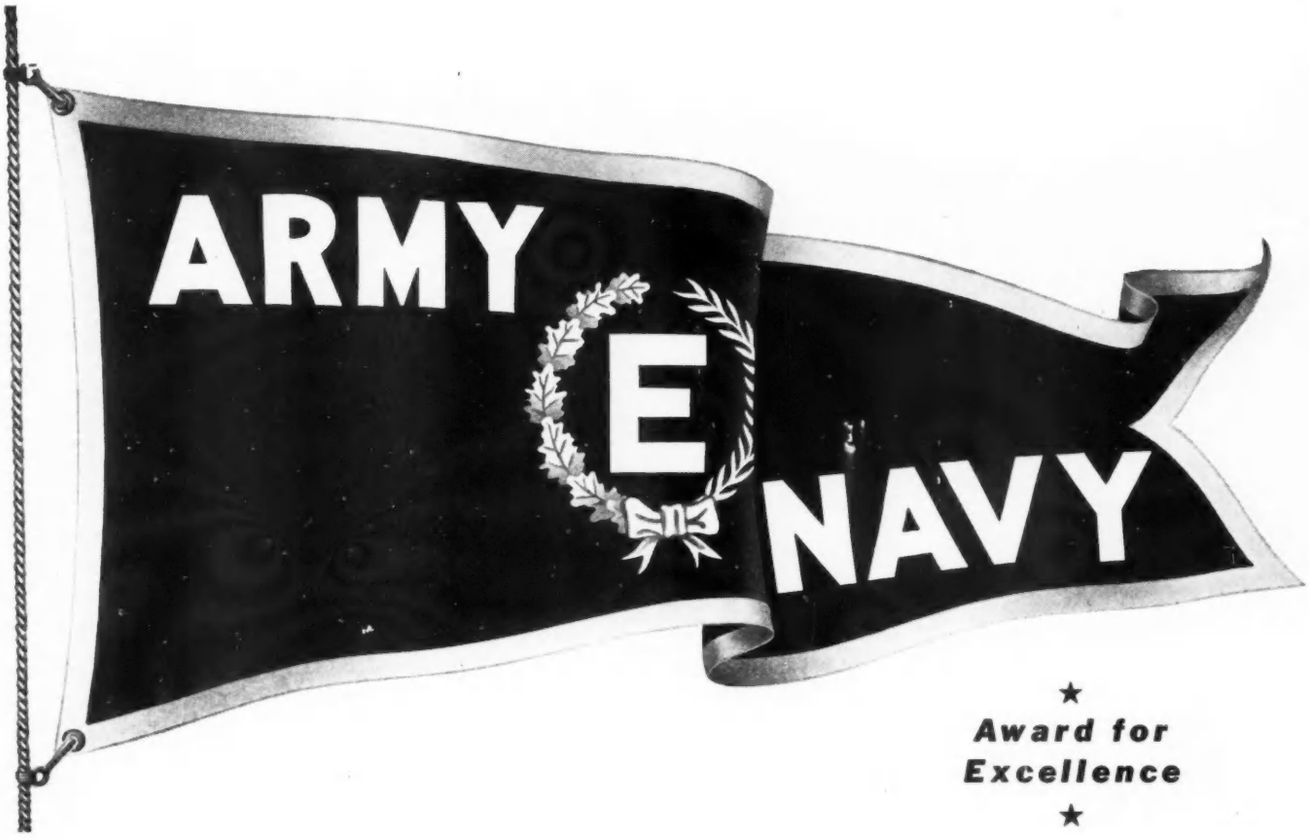
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ARMY-NAVY PRODUCTION AWARD

for high achievement in the production of war equipment

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LINCOLN ENGINEERING COMPANY

We are proud to announce that we have been awarded the Army and Navy "E"—the coveted emblem conferred by the United States Army and Navy for high achievement in the production of war equipment.

This achievement has resulted from the combined efforts of every man and woman in the employ of the Lincoln Engineering Company. The "E" pin which each person in our organization wears, and the "E" pennant that flies over the Lincoln plant serve as silent inspiration toward greater and greater accomplishment until the time of final and complete Victory.

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LINCOLN ENGINEERING COMPANY, ST. LOUIS, MO., U. S. A.

Pioneer Builders of Engineered Lubricating Equipment

42 100

As the Record on Rubber Unfolds

(*Continued from page* 171)

March 7—Rubber Reserve Co. agrees with IRRC to buy additional 100,000 tons of rubber pursuant to prior understanding.

March 25—Jesse Jones announces synthetic program for four plants with initial equipment for annual production of 2500 tons each.
(In testifying before the Truman Committee later regarding the cut from original proposal of 100,000 tons to 10,000 tons, W. L. Batt said, "there was a difference of opinion between us, on the one side, and Mr. Jones—and I understand Mr. Jones is supported by the President— on the other side, as to the necessity for that large a program at that time." Jones denied that difference existed.)

April — OPM investigation reveals plant capacity for production of raw materials for 100,000-ton synthetic program does not exist.

April 14 — RUSSO-JAP PEACE PACT. Japan now free to strike in Pacific.

April 30—Rubber Reserve Co. has accumulated 97,947 tons of reserve rubber, 13,000 tons in transit, 37,000 tons awaiting shipment.

May—Du Pont announces construction of a Neoprene plant with a capacity of 10,000 long tons per year.
—Dow Chemical Co. opens new Thiokol plant with production capacity of more than 150,000 pounds per month.
—Jesse Jones announces that Rubber Reserve Co. has agreed with IRRC to purchase up to 430,000 tons of rubber together with 24,000 tons of Brazilian rubber in '41 and '42.

May 1—Dr. E. W. Reid, Ass't Chief of Chemical and Allied Section, OPM, asserts that plants projected by RFC are of no value since plants of that size have been operating privately.

May 5—Government revokes all licenses for shipment of scrap rubber to Japan and occupied parts of China.

May 6—London Rubber Trade Association and the British Ministry of Supply agree on control of rubber imports. Believed to assist Rubber Reserve Co. in building stock pile.

May 6—FRENCH INDO-CHINA, JAPAN AND FRANCE SIGN PACT FOR ECONOMIC COLLABORATION BETWEEN JAPAN AND INDO-CHINA.

May 9—William S. Knudsen urges Jesse Jones to increase initial production of projected synthetic plants to annual capacity of 10,000 tons each.

May 16—Jesse Jones announces that Defense Plant Corp. has authorized construction of synthetic plants by four major companies, each plant to have capacity of 2500 tons per year and ultimate capacity of 10,000 tons each. Cost $1,250,000.

May 27—President proclaims UNLIMITED EMERGENCY and asks Congress for $3.319 billion, mainly for airplanes.

May 31—Rubber stocks held by RFC aggregate 186,840 tons. Reserves in hands of manufacturers and dealers, approximately 172,000 tons. Stocks afloat, 147,000 tons.

June—OPM estimates present synthetic production rate to be 9800 tons per year.

June 2—Dr. Waldo L. Semon, B. F. Goodrich Co., says, "expenditure of $200 million would assure capacity of 300,000 tons of synthetic per year. Without question large synthetic rubber plants must be built. Capacity must be available so that in case natural rubber ceases to come, synthetic plants can produce immediately at rate of 100,000 to 400,000 tons per year."

June 11—Representative Anderson introduces bill in Congress calling



A NEW SOURCE FOR TURNBUCKLES

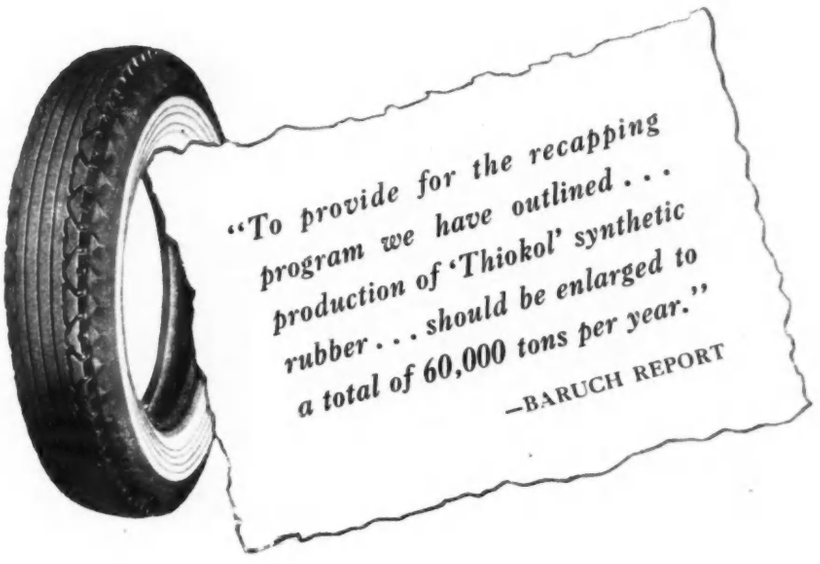
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High-production precision machinery, formerly used on commercial products, has recently been adapted for the manufacture of aircraft turnbuckles to Army and Navy specifications. This organization is backed by fifteen years of experience in the manufacture of precision parts for aircraft—experience that guarantees you will receive maximum value and satisfaction. Write or wire us your needs and we will furnish a prompt quotation. Send for our Turnbuckle Circular containing valuable engineering data and prices.

Other products will be announced in the near future.

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America Will Get Those 60,000 Tons!

THE Baruch Committee recently stated that 60,000 tons of Thiokol* synthetic rubber, Type "N," will be needed to help carry civilian passenger tires through the year 1943. Another 60,000 tons will be needed for 1944. The Committee recommended that Thiokol* Type "N," "the most rapidly produced of all synthetic materials suitable for retreading civilian tires," be used specifically to provide transportation for war workers. The Committee estimated that as many as 25,000,000 recaps per year might be necessary to keep essential civilian cars on the road.

We welcome the responsibility imposed on Thiokol Corporation by the findings of the Baruch Committee. Producing and supervising the production of 60,000 tons of Thiokol* synthetic rubber Type "N" is a big job—but *it will be done.* To the entire nation we pledge our unremitting efforts to attain the objective as soon as humanly possible.

Thiokol Corporation pledges, too, that fulfilment of its tremendous new assignment will be carried out without impairing production of the other types of Thiokol* synthetic rubber so essential in airplanes, tanks and ships.

Thiokol Corporation, Trenton, New Jersey

Thiokol* **SYNTHETIC RUBBER**

"America's First"

*Thiokol Corporation trade-mark, Reg. U. S. Pat. Off.

for planting of 45,000 acres of guayule (would supply about 5 per cent of one year's needs).

June 20—OPM issues preference order on rubber and rubber products designed to reduce consumption approximately 20 per cent by end of current year, to enable RRC to achieve its goal, and to expand it to 430,000 tons which, together with bartered rubber (for cotton) should give government an inventory of 570,000 long tons by end of 1941.

June 21—GERMANY DECLARES WAR ON RUSSIA.

June 27—Report from Singapore states Netherlands Indies will discontinue all sales of rubber to Japanese at end of '41.

June 29—House Military Committee declares a series of major failures and delays has left U. S. seriously lacking in strategic materials. Principal cause laid to absence of responsible head with authority and power to act.

July 1—RFC orders initial synthetic capacity increased to 40,000 tons.

Aug. 4—Japanese shipping to United States suspended.

Aug. 6—Jesse Jones states that stock pile owned by RRC amounts to 225,000 tons.

Aug. 9—E. R. Stettinius, Jr., Director of Priorities, OPM, issues order prohibiting manufacture of white side wall tires to save 6000 tons of crude rubber.

Aug. 19—IRRC, meeting in London, raises the permissible export quota from the East Indies for fourth quarter to 120 per cent.

Sept. 15—Jesse Jones writes the President, "On Sept. 13, 1941, 140,318 tons (of rubber) had been delivered, 66,391 tons were in transit and 150,601 tons awaited shipment * * * Through the operation of central buying, the balance of 430,000 tons should be accumulated by June 30, 1942."

Oct. 16—Jap naval officer declares, "*Relations between Japan and United States are now approaching the final parting of ways, and the Japanese Navy is ready and itching for action if need be.*"

Oct. 25—Navy Secretary Knox declares U. S. has given up all hope of coming to terms with Japan. Sees war as inevitable.

Nov. 12—Jesse Jones announces that Defense Plant Corp. has authorized lease agreements for plants to manufacture raw materials for synthetic rubber; $3,500,000 to Carbide and Chemicals Corp., for butadiene, $2,200,000 to Monsanto Chemical Co. for other chemical products.

Nov. 26—U. S. Embassy urges all Americans to leave Japan at once.

Dec. 7—PEARL HARBOR.

Dec. 8—CONGRESS DECLARES WAR ON JAPAN, FOLLOWED BY SIMILAR DECLARATIONS BY BRITAIN, CANADA, CHINA, DUTCH EAST INDIES.

Dec. 8—THAILAND JOINS JAPANESE.

Dec. 10—Jesse Jones before Senate Military Affairs Committee estimates current supplies supplemented by increased production of synthetics can be stretched enough to meet absolute essential needs for two and one-half-year period.

Dec. 11—Tire sales banned until December 22nd. Later prohibited until January 4.

Dec. 11—Economic Defense Board prohibits exportation of tires and other rubber products, except under provision of Lend-Lease Act.

Dec. 11—GERMANY AND ITALY DECLARE WAR ON THE UNITED STATES; CONGRESS RETALIATES WITH WAR DECLARATIONS.

Dec. 17—Leon Henderson announces at press conference that tires will be rationed after January 4 through local rationing boards.

Dec. 17—Leon Henderson says "expanding needs of the military forces, plus the uncertainty over the possibility of getting further imports, make it imperative * * * that we cut our civilian consumption to not more than 10,000 tons of crude rubber per month."



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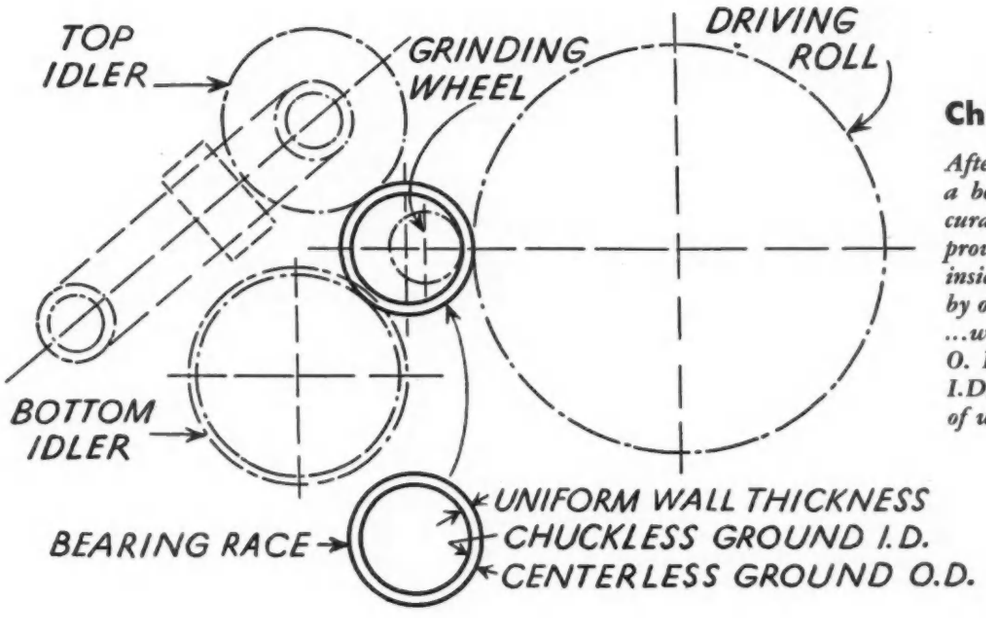
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After the outside diameter of a bearing race has been accurately ground by our improved centerless method, the inside diameter is controlled by our own chuckless method ...which utilizes finished race O. D. to produce concentric I.D. with absolute uniformity of wall thickness.

CHUCKLESS GRINDING is helping to speed up America's war effort... make precision manufacture possible at a mass production pace . . . and avoid material waste.

This entirely new grinding method was invented by Hyatt nearly twenty years ago. Our races have been produced by this precision process ever since.

Later, this great advance in grinding technique was made available to all industry.

Therefore, in addition to helping us make more and better Hyatt Roller Bearings for war machines, this gift from Hyatt helps other vital plants speed the day of an ultimate American victory.



Hyatt Bearings Division,
General Motors Corporation,
Harrison, N.J., San Francisco,
Chicago, Detroit, Pittsburgh.

THE 50TH YEAR OF HYATT *ROLLER BEARINGS*

Dec. 24—SPAB approves Jones' proposal to triple the present synthetic program. Jones believes if his plan becomes effective immediately the new plants could produce 120,000 tons beginning early next year.

Dec. 24—Donald Nelson issues order prohibiting shipment or delivery of new passenger cars with more than four tires.

Dec. 26—Tire rationing plan announced.

Dec. 31—OPA establishes maximum prices for new tires and tubes.

1942

Jan. 2—Temporary ban is placed on the retail sales, delivery, purchase, or lease of new passenger cars, new light trucks, and new heavy trucks pending the development of a rationing plan.

Jan. 2—MANILA FALLS TO JAPS.

Jan. 4—Jesse Jones calls in representatives of rubber and petroleum industries to advise him on setting up synthetic rubber program.

Jan. 6—President sets production goals; 1942—60,000 war planes, including 45,000 combat planes; 45,000 tanks, 20,000 anti-aircraft guns, 8 million deadweight tons of merchant shipping; 1943—125,000 warplanes, including 100,000 fighters and bombers; 75,000 tanks, 35,000 anti-aircraft guns, 10 million deadweight tons of merchant shipping, and wants the Germans and Japs to know it.

Jan. 11—JAPAN INVADES NETHERLANDS INDIES.

Jan. 12—Jesse Jones states RFC is authorizing constructing of synthetic plants with annual capacity of 400,000 tons.

Jan. 13—War Production Board organized with Donald Nelson as its single head.

Jan. 15—Leon Henderson says, "*It will be at least 18 months, and possibly longer, before any substantial quantity of synthetic rubber becomes available. According to reports today from the Far East, rubber plantations are being laid waste and processing plants destroyed to prevent their falling into Japanese hands. Under these circumstances, it is entirely possible that every pound of synthetic rubber that can be produced in the future may be needed for direct military use.*"

Jan. 20—Donald Nelson announces that he has approved a recommendation of the WPB to stop production of passenger cars and light trucks for either civilian or military use beginning Feb. 1.

Jan. 20—WPB announces that sales of tires or tubes to foreign governments under the terms of the Lend-Lease Act can be made only under quotas, allocations, or other restrictions that may be established from time to time.

Jan. 22—Henderson states that unnecessary removal by the government of tires from new passenger cars stored with dealers under the stock pile would be highly undesirable.

JAN. 31—MALAYA CONQUERED BY JAPS.

Feb.—600,000 tons of raw rubber reported on hand and afloat.

—Soviet Russia offers to exchange with the U. S. Government full information on manufacture of synthetic rubber. (According to Baruch report seven months later, no advantage was taken of this offer.)

Feb. 1—Amendment No. 3 to Supplementary Order M-15-b, drastically curtailing use of crude rubber, becomes effective.

Feb. 4—WPB tells members of the Rubber Industry Committee that an order will be issued shortly setting forth tire manufacturing specifications designed to save approximately 20,000 tons of rubber annually.

Feb. 11—WPB lays down stringent rules for the guidance of manufacturers of rubber products.



RECENTLY, before an important audience, two eminent machine tool authorities stated *that the intelligent study of cutting oil application may offer as much as 30% production* improvement in many plants. There are indisputable facts behind that statement!

Cutting oil application should not be a matter of "guess and hope" or habit. It need not be; for there are Stuart Oil Engineers, specialists of broad experience, skilled in solving cutting oil application problems, ready to help you.*

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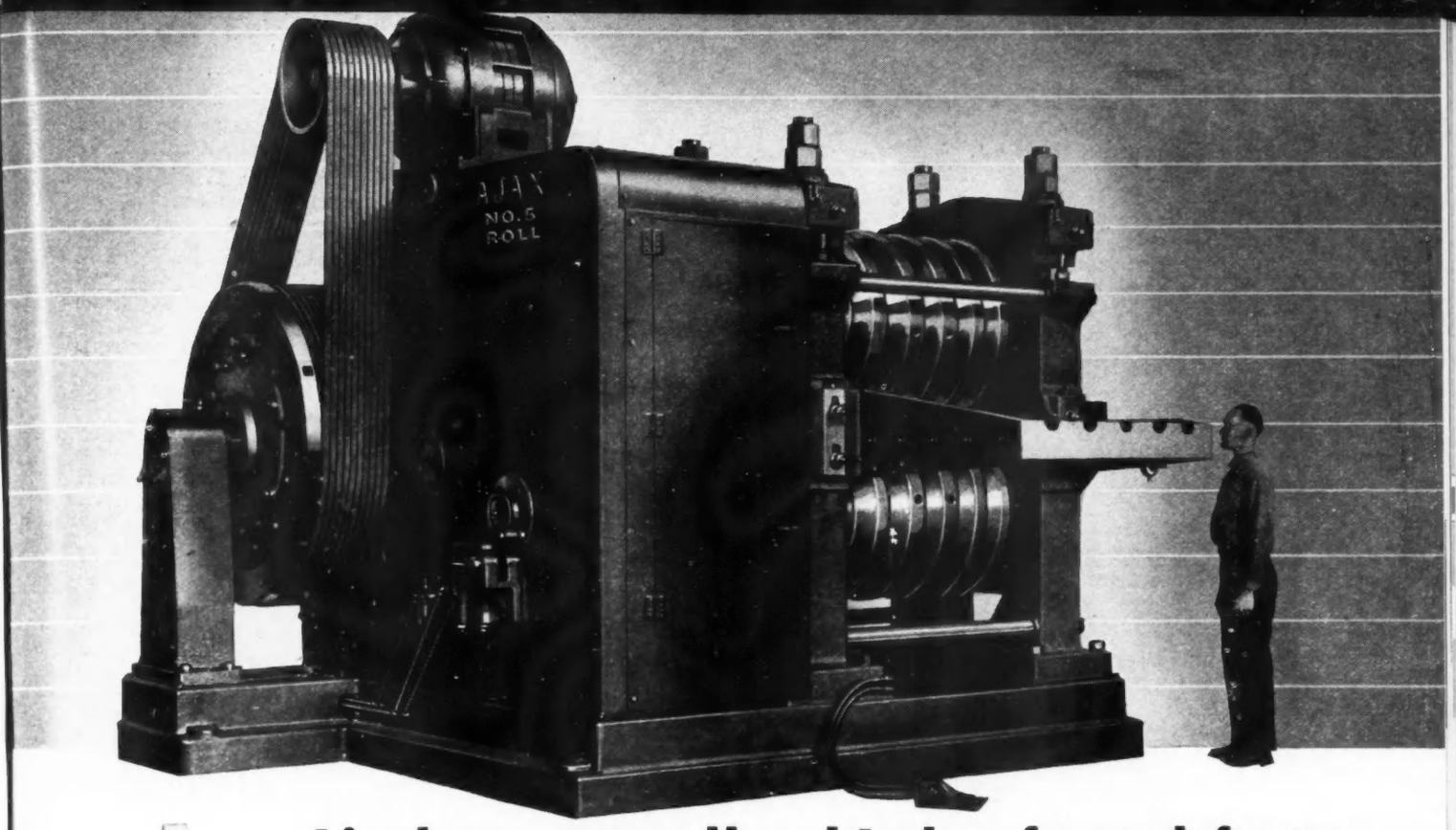
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AJAX *WIDE ADJUSTMENT* FORGING ROLLS

The speed and facility with which Ajax Wide Adjustment Forging Rolls draw the long tapered blanks for airplane propeller blades preparatory to finish forging in a hammer makes them indispensable in propeller production. The rolling operation is fast and the blanks are drawn accurately to cross-sections which fill out the entire length of hammer die impressions with negligible flash and a minimum number of hammer blows consistent with thorough working of the metal.

Of vital importance is the assurance that finished propellers drawn on Ajax Forging Rolls are absolutely free from transverse fiber interruptions that occur when blanks are drawn on a hammer and result in fatigue failures in flying service.

Blanks of steel, aluminum and magnesium are being drawn for a wide range of military and industrial products on Ajax Wide Adjustment Forging Rolls. Their operation is extremely simple and their production, particularly on long draws, is many times that of the fastest swagers or trip hammers.

An outstanding improvement is the wide adjustment gearing (patented). It permits adjustment between roll dies approximately 6 times that of earlier designs, thus reducing die maintenance to a fraction of former requirements. Backlash is eliminated and the smooth operation of these rolls is reflected in the regularity of the surfaces rolled.

Ajax Forging Rolls are made in five sizes covering the entire field of forging that can be handled manually. All sizes possess outstanding Ajax features that merit your purchase of Ajax Wide Adjustment Forging Rolls on the basis of mechanical soundness. Write for Bulletin 91-A.



Blade Blank having extruded tong hold and blank drawn to tapered elliptical section prior to hammer forging.

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Specifications embodied in Supplementary Order M-15-b-1.

Feb. 15 — SINGAPORE SURRENDERS.

Feb. 18—Local rationing boards instructed not to accept applications or issue certificates for the purchase of retreaded or recapped tires for buses, trucks, and other heavy vehicles until February 23.

Feb. 19—Nationwide rationing of retreaded and recapped tires begins. OPA announces "*it is possible and even probable that there will be no crude rubber available for retreading of passenger car tires except for those vehicles already eligible for new tires.*"

Feb. 27—Leon Henderson announces completion of plan by which tire dealers and jobbers can dispose of their stocks of new passenger car tires and tubes. Plan involves sales of tires and tubes to original manufacturers for cost plus ten per cent. Manufacturers are then required to sell returned products to the Defense Supplies Corp.

Feb. 27—JAPAN INVADES JAVA.

Mar. 5—Leon Henderson tells Truman Committee a total of 7,500,000 passenger cars out of 30,000,000 can be maintained in operation during the next three years, and presents the following table on the United Nations crude rubber outlook.

UNITED NATIONS CRUDE RUBBER OUTLOOK

Supply	1942	1943	1944
Crude Rubber Shipments	434,000	135,000	98,000
Synthetic Rubber	25,000	300,000	600,000
U. S. Crown Guayule	.....	1,000	5,000
Total (Tons)	459,000	436,000	703,000
Demand			
U. S. Military Forces	*306,750	*462,750	*462,750
Lend-Lease, South American Export			
U. S. Civilian	*150,000	*123,750	*123,750
Rest of Non-Axis World	*198,750	*198,750	*198,750
Total (Tons)	*655,500	785,250	*785,250
Result			
Supply Minus Demand	196,500	349,250	82,250
Total Stocks at Beginning of Year	693,000	496,500	147,250
Net Stocks End of Year for Next Year (Tons)	496,500	147,250	65,000

* Showing effect of a 25 per cent reduction in demand which will be met.

Mar. 5—After veto of original bill by the President, because it prevented planting of guayule in South America, an amended guayule bill is passed and signed by the President. Forest Service, Dept. of Agriculture, begins work on the Guayule Emergency Project in the Salinas Valley.

Mar. 10—WPB rules that production of farm tractors requiring rubber tires must be stopped by May 1, 1942.

Mar. 21—Strict controls on the use and sale of scrap and reclaimed rubber put into effect.

Mar. 24—William L. Batt (WPB) testifies before Senate Defense Investigating Committee that Jesse Jones overruled recommendations in 1940 for building up synthetic rubber production to 100,000 tons annually because he did not believe it was necessary. Mr. Batt adds, "I understand that he was supported by the President."

Mar. 25—JAPAN OCCUPIES ANDAMAN ISLANDS.

Mar. 25—Consent decree filed with Federal Court by Standard Oil of N. J. and IGF, German chemical trust, is announced by Department of Justice as releasing patents for manufacture of synthetic rubber, gasoline, etc., royalty free, to American industry for duration of war and six months thereafter. (See item in this chronology under date Aug. 19, 1942.)

Mar. 31—President Farish, Standard Oil of N. J., tells Senate Defense Investigating Committee there is not "a shadow of foundation" to the charges that his company retarded synthetic rubber production.

Apr.—Simon Neuman, President of Publicker Alcohol Co., presents plan for production of Butadiene from alcohol to the Rubber Reserve Co.

Apr. 1—Jesse Jones announces that contracts with 25 oil, chemical, and rubber companies should yield pro-



Ashore or afloat . . . as our armed forces move into one brilliant new action after another . . . you'll find "BENDIX" DRIVES in at the start.

Like more than 60,000,000 motorists before them, our fighting men can take the starting of their mechanized equipment for granted. Engineered into many of the motor-driven units used by our specialists in military offense are the sturdy "BENDIX" DRIVES, backed by a record of swift, sure starts that figures in billions.



"BENDIX" DRIVE is an important member of "The Invisible Crew," which includes the precision instruments and equipment made by 15 Bendix Divisions, serving with our fighting crews on every front.

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Like hundreds of other plant items, even the best chucks—or anything else for that matter—wear out *some* time.

If new stocks are scarce and your want is immediate, you "need a friend" in a big hurry. *Here he is,* all set to give you the help you need—just call the Representative of your nearby Industrial Supply Distributor. For, even if *he* hasn't any in stock, he is almost sure to know many possible sources that may be closed to you. So when he says "don't worry—we'll scout up an emergency supply for you if there's any in town," you can be sure he will make every effort to keep you going. And usually he will *succeed.*

It's good business to take your own Distributors into your confidence and use them all the time. We know, because for many years they have been *our* Sales Representatives on Cle-Forge High-Speed Drills and Peerless High-Speed Reamers throughout Industrial America.

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duction of 700,000 tons of synthetic rubber in U. S. annually by end of 1943. "It is important that civilian automobiles should outlast the war," he says, pointing out that an investment of about $15 for each automobile will make possible construction of synthetic plants to produce enough for all civilian vehicles.

Apr. 4—WPB announces amendment to rubber Order M-15b-1 permitting recaps for defense workers to be made of reclaimed rubber with small quantity of crude.

Apr. 6—Jesse Jones tells Senate Defense Investigating Committee present synthetic program calls for 700,000 tons annually by end of 1943. He characterizes hopes of getting greatly increased supplies of natural rubber from Central and South America and from the guayule growing as "greatly exaggerated."

Apr. 7—Jesse Jones tells Senate Defense Investigating Committee stock pile of natural rubber is now 700,000 tons and that we should have 300,000 tons of synthetic in 1943, and 700,000 tons in 1944.

Apr. 7—Leon Henderson says war workers will get tires only when they cannot get to work without them.

Apr. 8—Petroleum Industry War Council proposes production of minimum of 300,000 tons of synthetic rubber a year for civilian use over and above the 700,000 tons already planned by Government agencies.

Apr. 8—Executive Vice - President, Standard Oil of N. J., tells Academy of Political Science it will be at least two years before average motorist may get relief from present tire restrictions.

Apr. 9—BATAAN PENINSULA OCCUPIED BY JAPAN.

Apr. 16—Goodyear announces test cars running "on tires without rubber," says civilian motorists may expect new synthetic rubber tires in a year and a half or two years.

Ford Motor Co. announces process for treating fabrics by using not more than 1/16 the amount of rubber heretofore used in tire manufacture. OPA denies reports it is surveying supplies of used tires in New England as forerunner of tire requisitioning.

Apr. 18—Leon Henderson announces plan to allot emergency reserves of tires to some long-distance truck and bus operators.

Apr. 21—WPB orders discontinuance of production of rubber-tired farm machinery after April 30.

Apr. 21—President issues directive to Alien Property Custodian to seize all patents controlled by enemy aliens, either directly or indirectly.

Apr. 23—U. S. Government agrees to help in the rubber development resources of Peru with Rubber Reserve Co. acquiring all rubber produced in excess of amount needed for essential uses in that country for a period of five years.

Apr. 25—Senator Herring, Chairman of Senate Subcommittee investigating rubber, charges that estimates of 600,000 to 700,000 tons for Army and Navy were set much too high. Predicts that civilian tires will not wear out before synthetic and substitute products are available.

Apr. 25—WPB authorizes RFC to increase production of Buna synthetic by 100,000 tons to reach productive capacity of 700,000 tons by end of 1943.

Apr. 25—Nicaragua agrees to make available to U. S. all its exportable crude rubber.

May 6—CORREGIDOR SURRENDERS.

May 7—Under Secretary of War Patterson, states that government plans to buy extra tires but will allow one spare "for the time being." Several senators expressed strong disapproval of plans to requisition cars or tires.

May 7—Elliott E. Simpson, independent rubber dealer, testifies before House Committee that "*the President and the American peo-*

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Centrifuge savings are applied to small shops like this and to hundreds of machines of all kinds employing thousands of gallons of coolants.

Machines take their worst beating when allowed to run with coolants and lubricants containing accumulated grit and other contamination. Merely separating chips and returning the coolant plus make-up is both unsafe and costly.

Clarification with a National Acme precision built centrifuge removes all the finely divided gritty materials, and tangible savings in any shop are these —

You grind and replace cutting tools less frequently.

A higher percentage of your product passes inspection.

Machine bearings and other operating parts show much slower deterioration.

You materially reduce both the quantities and costs of coolants and lubricants.

Our centrifuge engineers will freely show you the application best suited to your shop. *Complete Catalog, P-41.*



Destructive grit removed from coolant used one day.

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ACME-GRIDLEY 4-6 AND 8 SPINDLE BAR AND CHUCKING AUTOMATICS • SINGLE SPINDLE AUTOMATICS • AUTOMATIC THREADING DIES AND TAPS • SCREW MACHINE PRODUCTS • THE CHRONOLOG • LIMIT SWITCHES • SOLENOIDS • POSITIVE CENTRIFUGE • CONTRACT MANUFACTURING

ple have been sold a gold brick by the fake rubber shortage."

May 7—Brazilian Minister of Finance announces that U. S. will purchase all rubber produced in Brazil, less requirements of that country's internal market, for next five years.

May 9—Jesse Jones tells Senate Banking and Currency Committee that RFC and subsidiaries have made commitments of $700 million for construction of synthetic rubber plants with capacity of 800,000 tons a year, which, "should come in production during 1942 and 1943."

May 9 — Secretary of Agriculture Wickard says 80 million bushels of surplus wheat and corn could be used to produce butadiene for synthetic rubber.

May 12—Senate Agriculture Subcommittee complains that government officials have displayed "a remarkable lack of interest in processes in which domestic farm products are basic raw materials" for synthetic rubber.

May 14—Firestone Tire and Rubber Co. announces manufacture of "the first synthetic rubber to be produced in any of the new synthetic rubber plants being erected for the Government's Defense Plant Corp."

May 14—Acrylonitrile, ingredient of Buna N synthetic rubber, placed under allocation.

May 16—Gallop Poll shows 400,000 families have laid up cars because of worn-out tires; by October an additional 4,400,000 cars will be laid up; and by May, 1943, a total of 12 million cars will be stored because of lack of tires. Only 1,800,000 owners think tires will last more than 2 years at present driving rate.

May 16—John D. Beebe, The B. F. Goodrich Co., predicts manufacture of synthetic and reclaimed rubber will meet both defense and non-defense needs by 1944.

May 19—Arthur Newhall, rubber coordinator, says nationwide rationing of gasoline as a means of conserving rubber is "inevitable by the end of summer."

May 21—Jesse Jones tells Senate Agriculture subcommittee he has recommended increase in synthetic rubber program to 1,000,000 tons a year.

May 22—Dr. Thomas Midgley, Jr., as Chairman of the Board of Directors, American Chemical Society, tells Chicago Section, "*Hitler did not start Word War II until the problem of making a satisfactory synthetic rubber was an accomplished fact. Today our relative positions with respect to rubber are reversed. Germany is not suffering in any critical way from rubber shortage. We are.*"

May 23—Joint statement by Chairman Nelson, WPB, Rubber Coordinator Newhall, Director Eastman of ODT and Henderson of OPA says no rubber can be spared for tires for ordinary passenger cars; all synthetic is needed for war effort during this year and next.

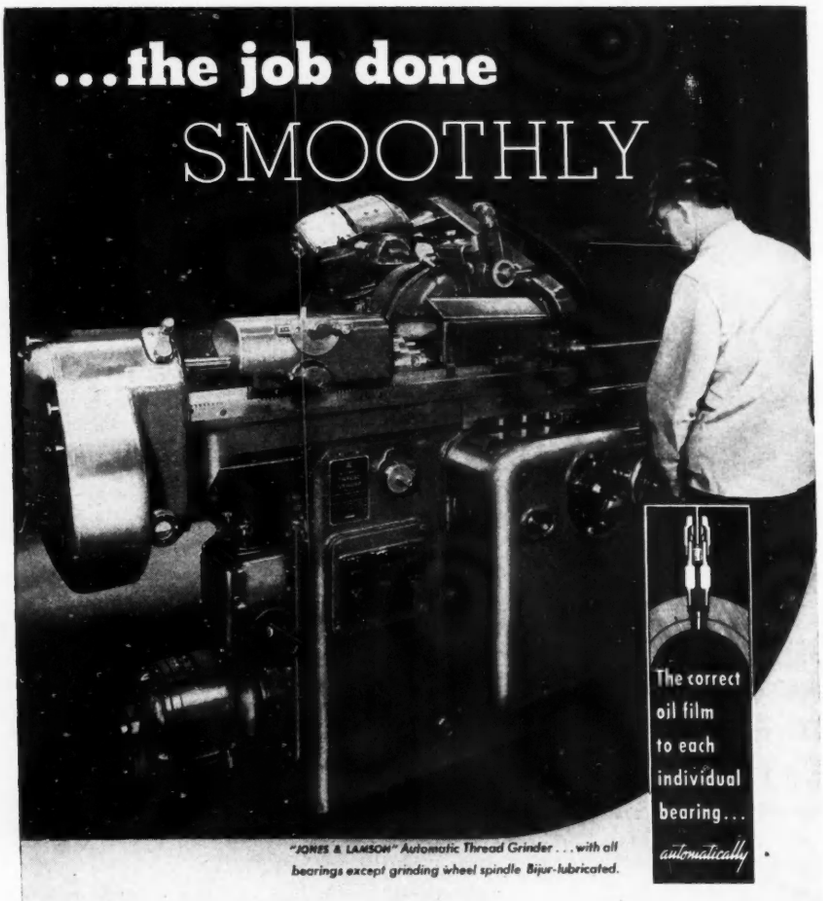
May 26—Senate Special Committee investigating national defense program (Truman) issues special report on rubber, criticizes lack of coordination in government efforts, and predicts no rubber for average motorist for three years.

May 26—President tells press conference he does not think there is anything in the rubber situation to be alarmed about. He expresses the belief that tires made of products other than natural rubber will be produced before all present tires were worn out.

May 27—WPB allocates 200 million gallons of alcohol derived from grain in 1943 to production of butadiene to make 200,000 tons of synthetic out of the 800,000-program.

May 28—WPB announces that butyl alcohol will be placed under complete allocation on July 1.

May 30—Senate Small Business Committee sponsors introduction of bill designed to keep serviceable



"JONES & LAMSON" Automatic Thread Grinder . . . with all bearings except grinding wheel spindle Bijur-lubricated.

● No time is lost from productive work . . . a BIJUR-equipped machine oils itself, while running! Metered oil-feed—the correct oil-film needed by each individual bearing—is supplied automatically. The efficiency of operator and machine is raised . . . precision standards are held . . . maintenance is reduced to a minimum . . . production stepped up!

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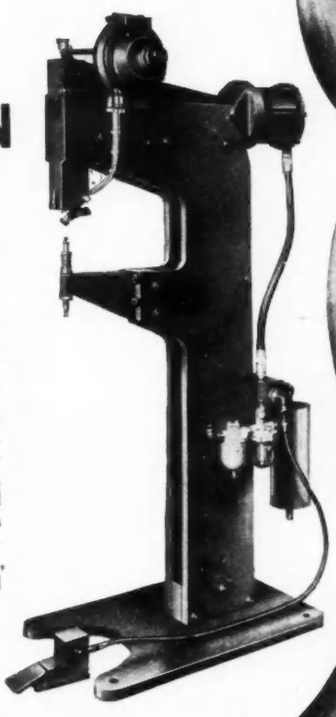
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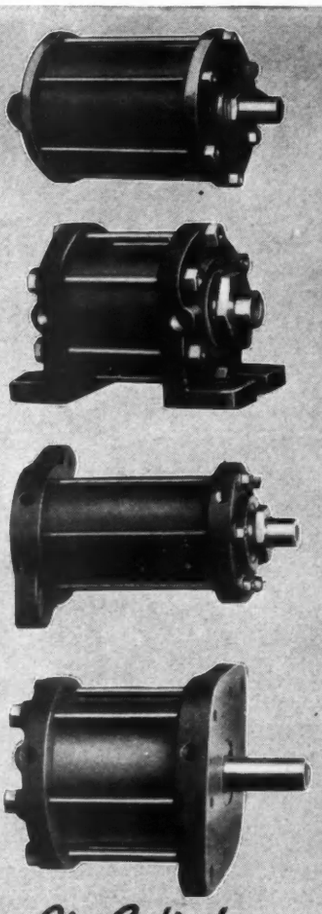
New

TOMKINS-JOHNSON
Air Powered
RIVITOR

(for aircraft production)

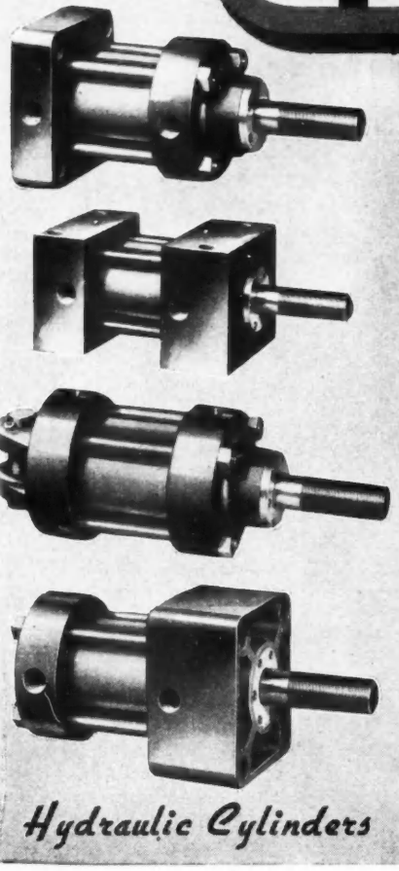
Furnishes "air squeeze" action combined with automatic feed riveting. In keeping with established T-J quality, this new RIVITOR contains many cost-cutting, efficiency building features — feeding and setting mechanisms are automatic . . . setting tools are adjustable . . . horn section is interchangeable. Steel side plates, base plate and non-repeating foot pedal operation, are other "pluses." By using a different type rivet set and jaw construction, Counter Sunk Head Rivets are handled, as well as Flat Head, Round Head, Full and Semi-Brazier Head Rivets. This high production T-J Air Powered Rivitor is your best choice for work within its range . . . write for production data, prices and deliveries, address to Dept. AI.





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T-J



Hydraulic Cylinders

EQUIPMENT
HELPS ATTAIN MAXIMUM SPEED IN PRODUCTION!

Increased performance and machine efficiency, plus greater handling convenience, are a few of the many advantges T-J products bring to machines and equipment engaged in today's high pressure defense production requirements.

T-J products . . . air and hydraulic cylinders . . . are easily and quickly installed . . . they become an integral part of the machine to which they are applied.

T-J AIR CYLINDERS

These units exert power movement from 100 lbs. to 12,000 lbs. (direct). Made in styles, sizes and strokes to meet your requirements.

T-J HYDRAULIC CYLINDERS

Designed and furnished in types and sizes to exert power movement from 1,000 lbs. to 50,000 lbs. (direct). Available to meet your specifications.

Our engineers are eager to help you step up production through the application of T-J products. Consult with them, regarding your requirements. Write for detailed data, address to Dept. AI.

THE TOMKINS-JOHNSON CO.
Jackson . . . Michigan

tires on 20 million automobiles for the duration, using only 3500 tons of crude rubber annually.

May 30—The Brookings Institution published this month a comprehensive study "Automobile Transportation in the War Effort" in which it was stated that "*if the pool of passenger cars in operative condition is permitted to drop much below 20,000,000, the civilian economy will be threatened with serious disruption . . . There is little prospect that the civilian economy will be able to draw either upon the existing stock pile of crude rubber or upon synthetic rubber production . . . If normal driving habits continue, the supply of tires will be completely exhausted by 1945 and the number of cars left in operating condition will drop below the minimum requirements (20,000,000) before the middle of 1943.*"

June 1—Dow Chemical Co. announces new Thiokol method for retreading one million tires a month.

June 2—Chairman Nelson, WPB, says official announcement of nationwide gasoline rationing may be made in less than a week.

June 3—JAPAN RAIDS DUTCH HARBOR.

June 4—Jesse Jones announces scrap rubber will be purchased by government through scrap dealers at $25 a ton in carload lots anywhere in the U. S.

June 6—Rubber Economics Subcommittee of Petroleum Industry War Council files report with governmental "appropriate agencies" on amount of rubber needed to keep civilian automobiles in operation.

June 6—Director Rogers, Division of Motor Transport, ODT, tells officials of teamsters union in Portland Oregon, it may be necessary to halt transportation of many consumer goods because of rubber shortage.

June 9—President suggests a two-week scrap rubber campaign.

June 9—Leon Henderson tells Senate Committee investigating petroleum shortage that military and essential civilian needs of the United Nations will exhaust all available rubber by end of 1942. He again predicts possibility of requisitioning tires or cars.

June 9—Rubber Coordinator Newhall tells Agriculture Subcommittee total 1942 production of synthetic is expected to be no more than 30,000 tons.

June 10—Rubber industry announces it will present to government officials plan for retreading, using Thiokol, which will keep civilian automobiles running.

June 11—Under Secretary of War Patterson tells Senate Banking and Currency Committee he is opposed to setting aside any crude or reclaimed rubber for ordinary civilian use. His statement applied to the Ellender Bill providing a small amount of rubber for recapping.

June 13—JAPAN OCCUPIES ATTU AND KISKA ISLANDS IN THE ALEUTIANS.

June 14—Lessing J. Rosenwald, chief of the WPB Bureau of Industrial Conservation, reveals plans for nationwide scrap rubber collection drive.

June 15—Three Senators call upon President to "break the WPB bottleneck" which they charge is holding up production of synthetic rubber. Call for appointment of a "rubber Czar."

June 16—State Department announces Rubber Reserve Co. will purchase entire Costa Rican rubber crop for five years.

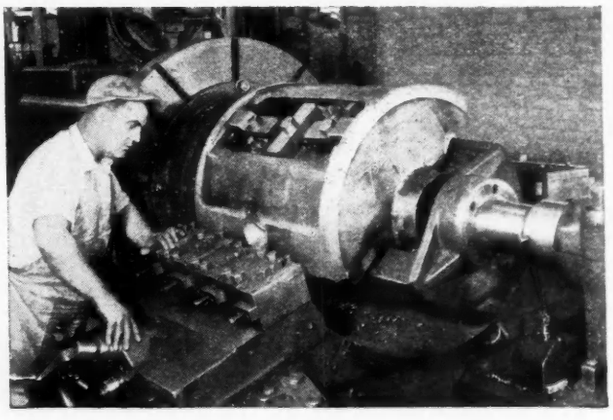
June 17—Rubber Coordinator Newhall says there will be no synthetic rubber for new passenger car tires for one year. Rubber to keep essential transportation going for duration must come from scrap.

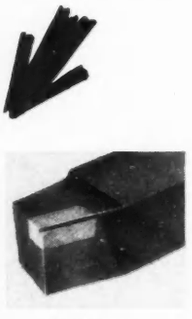
June 18—Senator Gillette introduces bill to set up "rubber supply agency" charged with the responsibility of providing and making available "at the earliest possible time an adequate supply of rub-

TANKS don't fight in arsenals



KENNAMETAL* is getting tanks into the battlefields





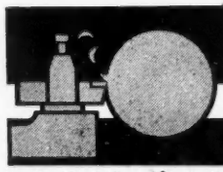
Style No. 11

The superior machining ability of KENNAMETAL Steel-Cutting Carbide Tools is evidenced every day in the great tank arsenals of America and the United Nations. Even in far away Australia, KENNAMETAL is widely employed in producing armaments to scrap the Axis.

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GRAND RAPIDS GRINDING

For Longer Lasting Accuracy from Tools and Cutters

Grand Rapids Universal Tool and Cutter Grinders and Drill and Tap Grinders are helping to get longer, more accurate service from all types of tools. Easy to set up, rapid in operation, they enable you to conserve valuable high speed tools, to keep them on the job longer, to maintain high output and consistent accuracy on war production jobs.

For Speed and Precision on Surface Grinding Jobs

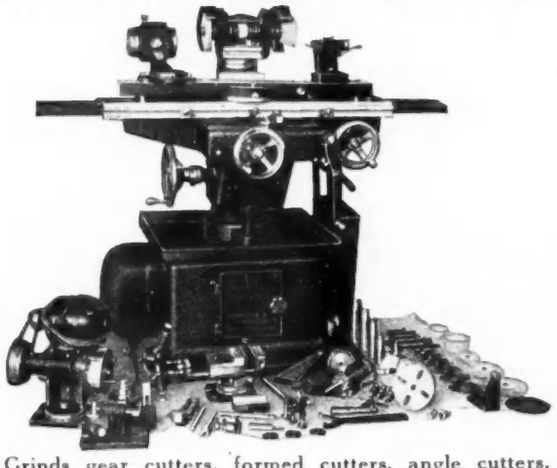
Grand Rapids Hydraulic Feed Precision Surface Grinders are equally capable of fine results on toolroom and manufacturing jobs. Their massive, one piece column and base and precision spindle mounting assure accuracy. Their convenient control features and variable speed hydraulic table feed assure rapidity of operation that has speeded up jobs of war production in every field.

Grand Rapids Drill and Tap Grinder



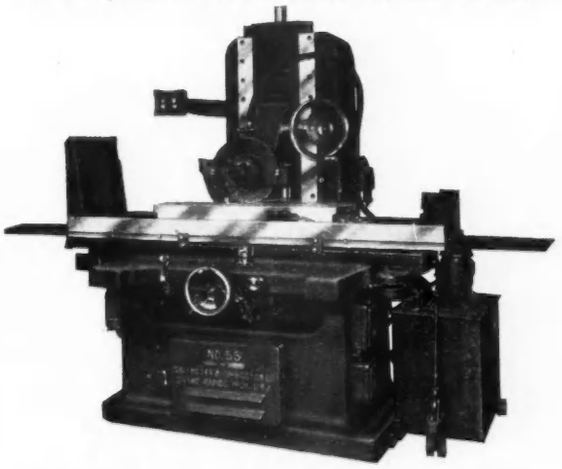
Automatically grinds correct angles on drills of all sizes, producing a drill point correctly centered with gradually increasing clearance that means faster, more accurate cutting. Quickly set up for grinding all types of taps. Write for descriptive bulletin.

Grand Rapids Universal Tool and Cutter Grinder



Grinds gear cutters, formed cutters, angle cutters, face mills, end mills, side mills, spiral and plain milling cutters, thread chasing tools, reamers, hobs, etc. Performs internal and surface grinding on precision toolroom jobs. Write for full details of this machine—a complete tool sharpening department in itself!

No. 55 Hydraulic Feed Precision Surface Grinder



One of a complete line with capacities from 14″ x 48″ to 6″ x 18″ described in Bulletin GL 100.

GALLMEYER & LIVINGSTON CO.

555 STRAIGHT AVE., S. W., GRAND RAPIDS, MICH.

ber . . . to meet military and civilian needs." The bill calls for greater quantities of butadiene from alcohol.

June 19—WPB on the recommendation of the Board of Economic Warfare prohibits the importation of rubber and rubber products except by subsidiaries of the Reconstruction Finance Corp.

June 20—Wendell Lund, WPB, tells House Committee that *"tires on non-essential private automobiles must be purchased by the government and allocated to war workers."*

June 20—Chairman of Indiana scrap rubber campaign telegraphs President saying statements on gasoline rationing and confiscation of private automobiles have in effect "sabotaged" the "belittled" scrap rubber collection drives.

June 23—Foreign Policy Association issues report touching on rivalries between different groups within and without the government for rubber program control.

June 25—War Department announces that Army will test large quantities of synthetic tires.

June 25—Dr. Hale, President of National Agrol Co., tells House Mining Subcommittee he can produce in a year all the rubber the nation needs if $100 million, the men and priorities are allowed him.

June 27—OPA sets higher prices on rubber scrap.

June 27—WPB places butadiene under allocation.

June 29—President extends scrap rubber drive for ten days.

June 29—WPB announces it will ask major tire companies to assume leadership in developing substitute for rubber tires.

June 29—OPA is reported as prepared to follow rubber scrap campaign with appeal to motorists to sell RFC all tires in excess of five per car.

July 1—Congressman Andresen introduces House Bill 7338 providing for an increased supply of rubber manufactured from alcohol.

July 1—Several congressmen assert conviction that WPB and RRC *"are not bending every effort to secure early production of synthetic rubber."*

July 6—Director Nelson, WPB, expresses opposition to Gillette Bill on grounds that manufacture of more synthetic rubber from farm commodities would require "critical material needed for the war effort" in the construction of plants.

July 6—President gets report showing that scrap rubber collections total 334,293 tons to July 3.

July 7—President tells press conference it is possible that war might take such a serious turn that government would seize all tires. He indicated, however, that he still hopes he will not need to ration gasoline nationally in order to conserve rubber and expressed desire to keep separate nationwide shortage of rubber and regional shortage of gasoline.

July 7—Rubber Coordinator Newhall, says approximately 6,000,000 tires have been retreaded with scrap since first of year.

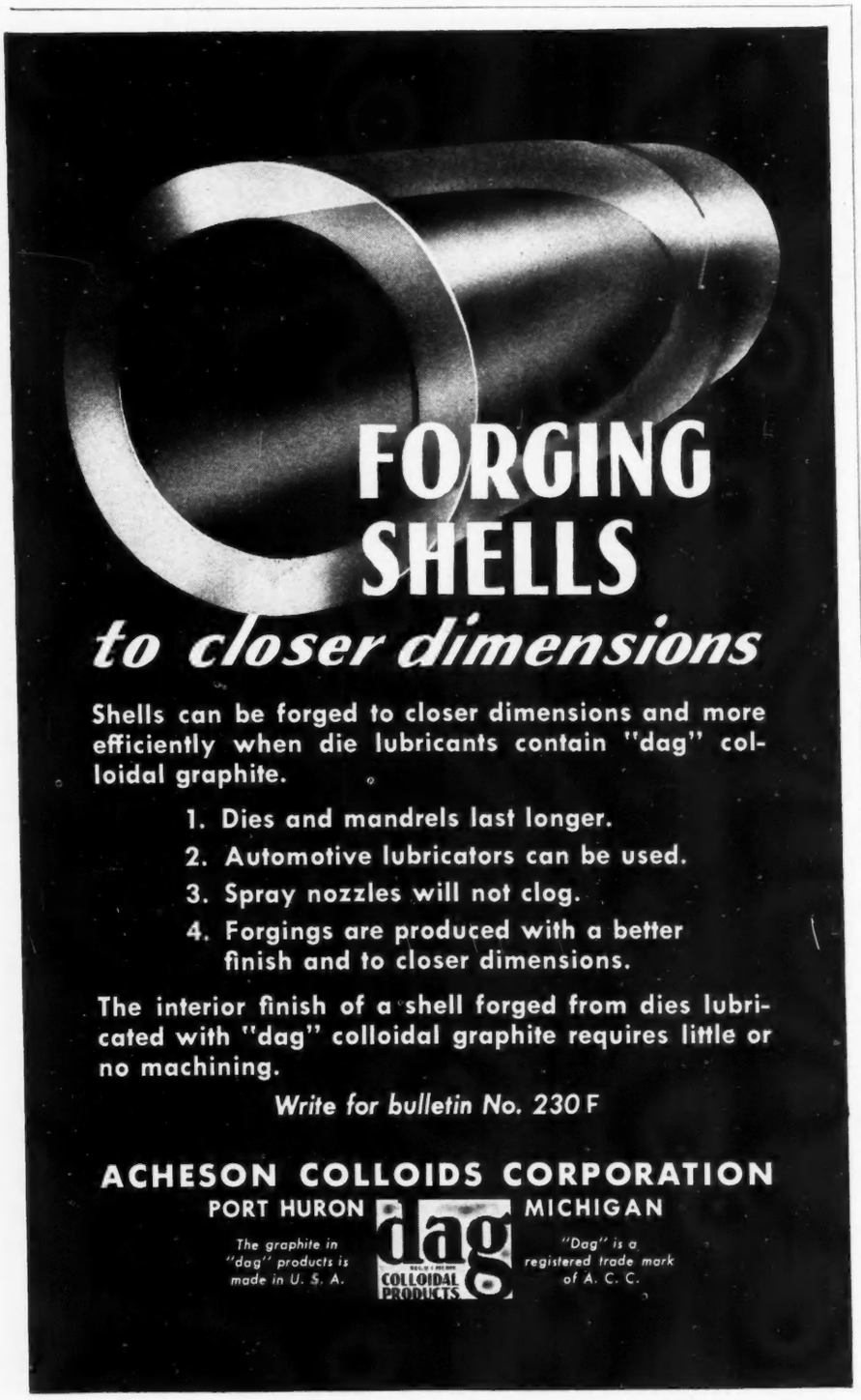
July 11—Dutch and British interests take exception to recent statements by Jesse Jones that their governments were unwilling to sell U. S. adequate supplies of raw rubber because of fear of price declines after war.

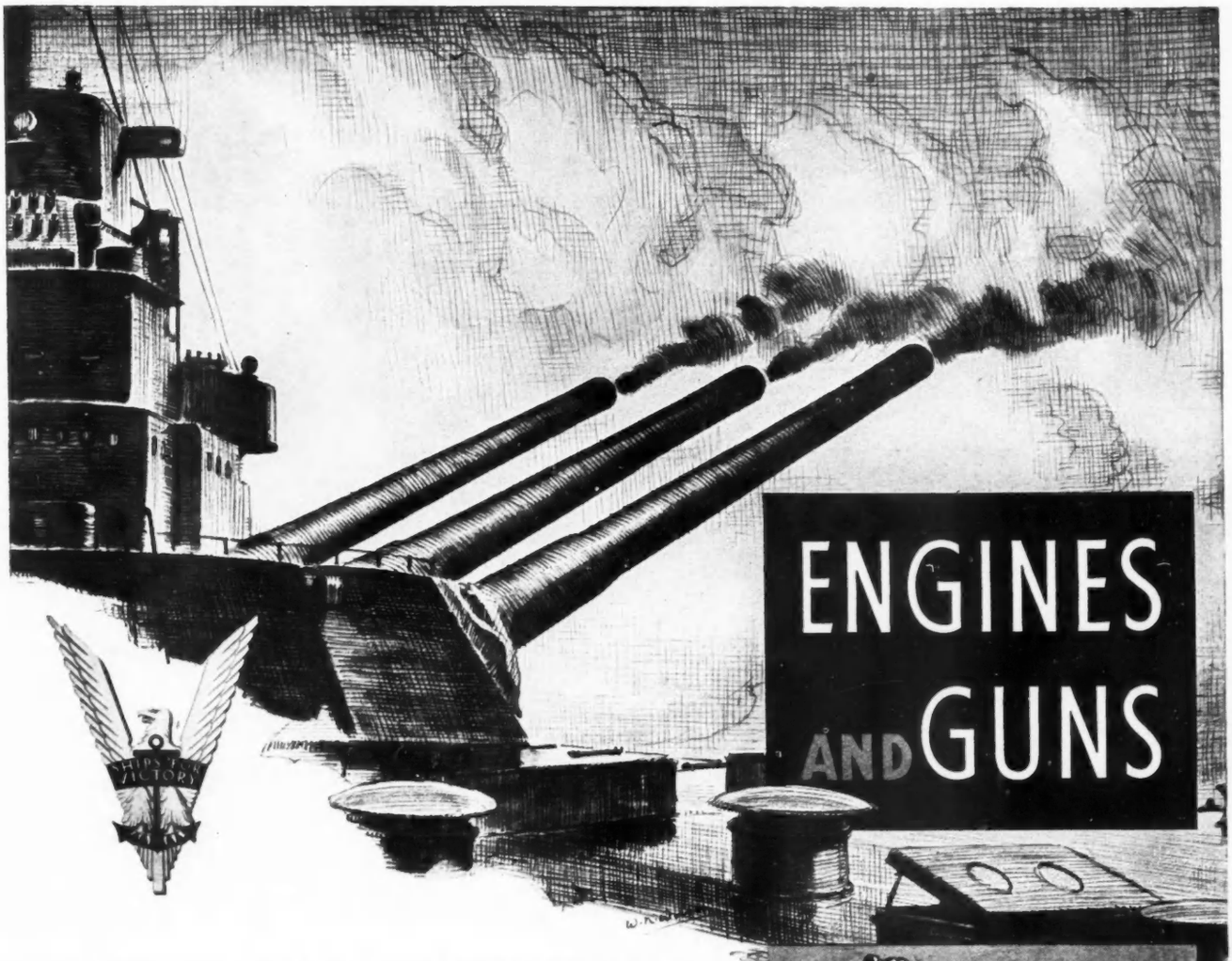
July 16—Petroleum War Industry Council urges *"that every means of producing rubber be taken advantage of promptly without regard to the source of materials or process used."*

July 16—State Department announces agreement with Bolivia to buy all that country's rubber except essential domestic requirements for next five years.

July 18—Rubber Coordinator Newhall, replying to critics of rubber program, promises enough rubber for "essential driving."

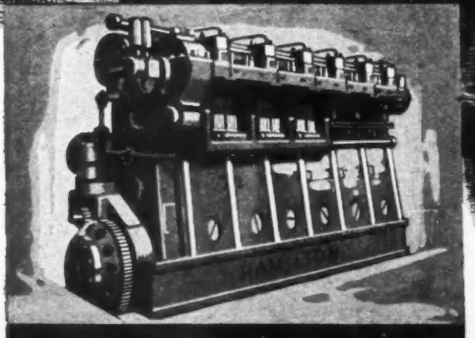
July 21—Rubber industry opens exhibits in Willard Hotel, Washing-

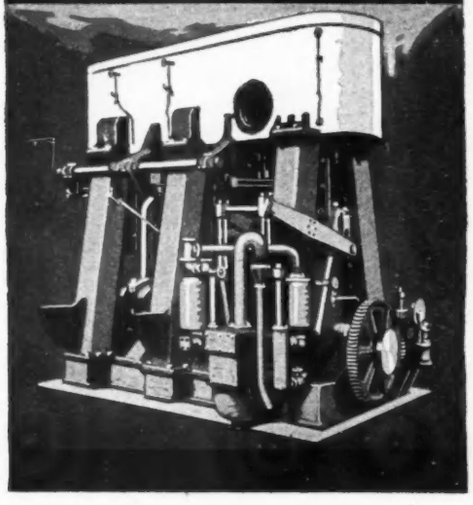




ENGINES AND GUNS are the legs and fists of fighting ships. In one of our plants we are turning out the engines. In another, many miles away, we are turning out the guns.

Other of our plants are working 'round the clock making machines to make guns, engines, armor plate and many another item essential to Uncle Sam's Armaments. All plants have been greatly expanded. But during this expansion the flood of Production has gone on without interruption. The 1942 total will be almost ten times that of 1939. We're on an all-out, full-time schedule, making the engines, guns and machine tools it takes to win the war and the peace that follows.





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CORPORATION

HAMILTON, OHIO

THE NILES TOOL WORKS CO.
THE HOOVEN, OWENS, RENTSCHLER CO.
GENERAL MACHINERY ORDNANCE CORPORATION

ton, and offers plan for providing tires for civilian use without interfering with military requirements.

July 21 — President announces that 454,155 tons of scrap rubber were collected between June 15 and July 10.

July 23—Senate passes Gillette Bill depriving WPB of authority of manufacture of synthetic from alcohol and creating an independent agency for this purpose.

July 23—WPB officials express variety of opinions regarding rubber industry's plan (See July 21) for providing tires for civilian use.

July 24—President tells press conference that, contrary to reports, he has not asked Chief Justice Stone to make survey of the rubber situation.

July 25—House passes counterpart of Gillette Bill for manufacture of rubber from alcohol with independent supervising agency.

Aug. 6—President vetoes Gillette Bill (alcohol and separate rubber agency) and appoints three-man committee: Bernard M. Baruch, Chairman; Karl T. Compton, President M.I.T., and James B. Conant, President of Harvard, "to study our rubber situation and to recommend action."

Aug. 12—WBP states that war orders amounting to approximately $130 billion have been placed during the first two years of the war effort.

Aug. 13—State Department announces agreements with Trinidad and British Guiana for purchase by U. S. of all exportable rubber for four years.

Aug. 18—State Department announces agreement with British Honduras to purchase all rubber until end of 1946.

Aug. 19—President Farish, Standard Oil of N. J., in a published statement points out that since 1910 "*Government has had the statutory right, in time of war as in time of peace, to use any patented invention for its own purposes. Largely through the efforts of Pres. Roosevelt in 1918, when Ass't. Sec'y. of Navy, this right of Government to use all patents was broadened . . . so that . . . Government could utilize any patented invention without consent of the owner or without any negotiation with him.*"

Aug. 21—OPA, acting on advice from the WPB, warns that rationing boards must make the "strictest possible interpretation" of a recent amendment to the tire rationing regulations which restricts truck eligibility to vehicles essential to the war effort or public health and safety.

Aug. 22—BRAZIL DECLARES WAR.

Sept. 9—At meeting of American Chemical Society, Dr. Albert L. Elder, technical advisor, WPB, predicts production of Buna S rubber at rate of 957,000 tons annually by 1944.

Sept. 10—President submits to Congress report of Baruch Committee. (Quotes from the Baruch report follow this chronology.)

Sept. 14—"*There was but one thing that mattered, really. We ought to have had rubber. To get rubber was the responsibility of the Administration. The rubber was not got.*" Mark Sullivan, New York Herald Tribune.

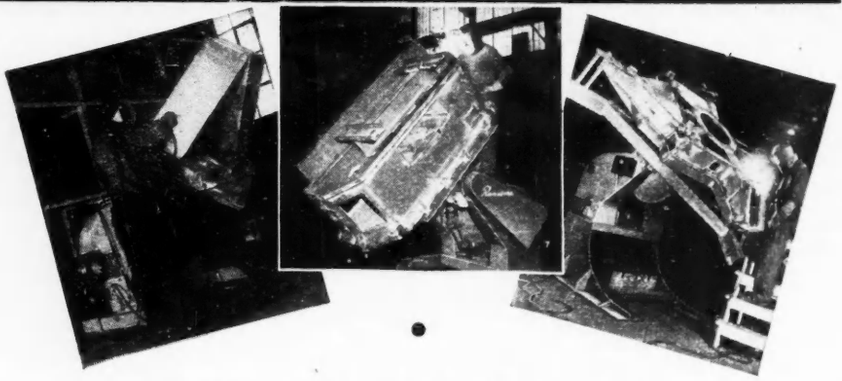
Sept. 15—William M. Jeffers, President of the Union Pacific Railroad, is appointed rubber administrator. (The Baruch committee recommended the appointment of an administrator "preferably with experience in the rubber industry."

Quotes from the Baruch Report

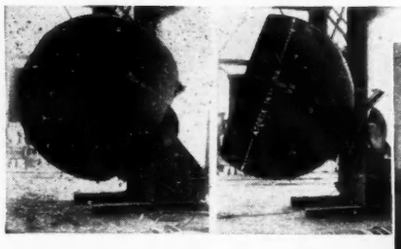
"We find the existing situation to be so dangerous that unless corrective measures are taken immediately this country will face both a military and civilian collapse. The naked facts present a warning that dare not be ignored."

"Unless adequate new supplies (natural or artificial) can be obtained in

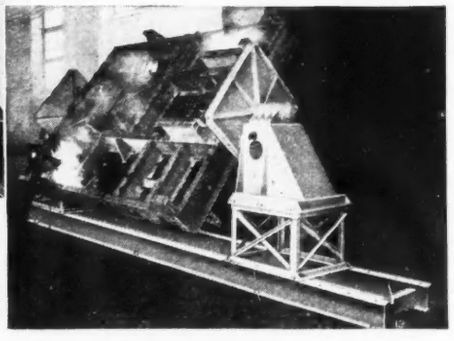
Ransome Welding Positioners for Greater Production



Left. Many-angled piece positioned for all down-hand welds.
Center. Heavy machine bases are of welded construction.
Right. A complicated weldment easily handled on a positioner.

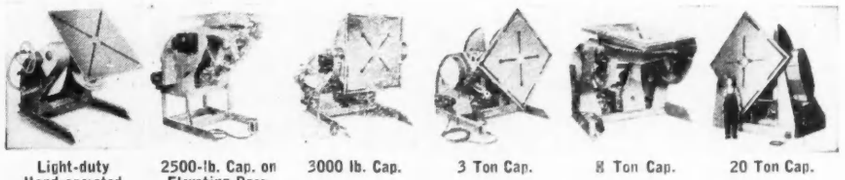


Standard positioner fitted with extension brackets for handling work larger than the table top, such as tanks, frames, etc.



Rotating Welding Fixtures consisting of motor-operated Head-stock with Tail-stock unit, handling large frame. Tail-stock is placed to accommodate objects of various lengths.

BOOTH B-102
NATIONAL METAL SHOW
CLEVELAND, OCT. 12-16



Light-duty Hand-operated | 2500-lb. Cap. on Elevating Base | 3000 lb. Cap. | 3 Ton Cap. | 8 Ton Cap. | 20 Ton Cap.

INDUSTRIAL DIVISION RANSOME MACHINERY CO. DUNELLEN NEW JERSEY

CAST FOR A LEADING ROLE IN INDUSTRY



This recirculating-type draw furnace permits accurate control of physical properties to attain desired characteristics.

Laboratory Methods Control the Properties of ArmaSteel*

As ArmaSteel castings advance toward the final stages of production, the methods and equipment used become more characteristic of a laboratory than of a foundry. For it is only by the most exacting control of these operations that ArmaSteel is fitted for its important role in industry.

Typical of this laboratory technique are the intricate system of automatic controls which regulate atmosphere and temperature in the radiant-gas-fired quenching furnace, and maintain accuracy of physical properties in the draw furnace . . . the constant and painstaking supervision that accompanies every precision operation . . . and the series of checks and tests, including cutting and coarse-etching, through which ArmaSteel castings must pass "all along the line." Most ArmaSteel parts are Brinelled and magna-fluxed either 100 per cent or at frequent intervals.

Close conformity to specifications, plus inherent machining advantages and performance characteristics, has made ArmaSteel castings indispensable for vital parts in many industries. With the critical shortage of steel and other materials which ArmaSteel supersedes in varied applications, it has become all the more advantageous for you to investigate the possibilities of ArmaSteel in your manufacturing operations. Our twenty-three years of practical foundry experience are at your disposal; write for catalog or consultation.

TYPICAL APPLICATIONS

Diesel pistons for heavy-duty locomotives . . . Automotive piston rings, camshafts, Hydra-Matic transmission gears, driveshaft universal yokes, clutch throw-out collars, valve rocker arms . . . Refrigerator crankshafts and connecting rods . . . Washing machine drive gears.

GM SAVE SERVE

Saginaw Malleable Iron Division
General Motors Corporation **Saginaw, Michigan**

*Reg. U.S. Pat. Off.

CAST FOR A LEADING ROLE IN INDUSTRY

time, the total military and export requirements alone will exhaust our crude stocks before the end of next summer."

"The Committee has examined the present status of the Government's schedules and estimates that if the present construction program can be met on the dates specified and technical difficulties in reaching full production are overcome, there will be produced during 1943:

400,000 tons of buna-s;

30,000 tons of neoprene (in part from private sources);

62,000 tons of butyl rubber; and

24,000 tons of thiokol (from private sources)."

"The War Production Board has fixed the total annual output of buna-s rubber at 705,000 tons for the United States. The Committee recommends that this ceiling be raised by 140,000 tons to 845,000 tons. Additional styrene and polymerization capacity should be built, as necessary, to take care of the increased production of butadiene. This expansion should be directed to produce the maximum possible amount of buna-s before January, 1, 1944."

"As a margin of safety on the military side, we recommend the construction of 20,000 tons a year of additional neoprene capacity."

"The Committee recommends that sufficient reclaimed rubber, a small amount of crude, and an increased supply of thiokol or other substitutes be made available immediately for making new tires and retreads for civilian use."

". . . At present the production of 24,000 tons (Thiokol) a year is planned. The committee recommends the expansion to 60,000 tons a year."

"The present program must be expanded to 1,100,000 tons of all synthetics."

". . . It has been estimated that by April of 1943, one-half of the tires on passenger automobiles will be worn to the point where they should be recapped. Clearly if such a condition is reached it would not be many months before our civilian economy collapsed."

"It must be remembered that practically nothing has been done during this year to supply tires for the 27,000,000 passenger cars now on the road."

"Failure of the responsible officials to request the aid of Russia in setting up our synthetic system is a neglect for which we have not had a satisfactory explanation. The Soviet Republics have been first or second in the production of this commodity, and we are asking that their know-how be obtained. The Soviet has expressed a willingness always to be cooperative. Russia has lost, through the German advance, between 50,000 and 60,000 tons of its rubber-making capacity."

". . . the country is dependent, finally, upon the production of synthetic rubber which, it is hoped, will reach its full swing in 1944. Why not earlier? Why so late? The answers to these queries lie in the past. These errors, growing out of procrastinations, indecisions, conflict of authority, clashes of personalities, lack of understanding, delays, and early nonuse of known alcohol processes, are not to be recounted by us, nor shall we go into the failure to build a greater stock pile of crude rubber.

To prevent a recurrence of these mistakes, this Committee asks an immediate reorganization in present method and the creation of a rubber administrator. This official will have authority over the policies governing the priceless stock of rubber now on our automobiles, the drivers of which are trustees of our national safety. He will direct the course of the technical and industrial development—wholly new to America—of the synthetic rubber production."

"The most important part of the plan is obviously the choice of the right man for the position of Rubber Administrator. He should be a thoroughly competent operating and manufacturing executive, preferably with experience in the rubber industry."



THE GUTS TO TAKE IT!



CORK THRUST PAD COMPENSATOR FOR HEAT AND EXPANSION OF WORK.

HEAVY DUTY BALL BEARING FOR GREATER THRUST LOAD.

GREASE SEAL TO RETAIN LUBRICANT.

HEAVY DUTY ROLLER BEARING FOR GREATER RADIAL LOAD CAPACITY

LARGE SPINDLE FOR STURDINESS AND GREATER LOAD.

LOCK NUT FOR REDRESSING POINT WITHOUT DISMANTLING.

NEEDLE BEARING FOR TRUE RUNNING.

THE CENTER OF ATTRACTION

The ADVANTAGES of MOTOR TOOL *Ball and Roller Bearing* LIVE CENTERS

are brought directly under your eye by this "inside" illustration. Note, also, the larger spindle—the small head—and the short overhang. Add all of these precision features together and the answer is clear why they WONT BURN OUT OR BREAK DOWN, even at highest speeds. They have the "guts" to take it.

But, seeing isn't always believing. PROVE IT!—in the same way it has been proved to manufacturers of army, navy and aircraft equipment. Watch these Centers do their stuff on the job—*your job*. COOL—always. And always ready to get going and KEEP GOING—on job after job.

With reasonable care, MOTOR TOOL LIVE CENTERS are GOOD for a lifetime of steady service.

MOTOR TOOL MANUFACTURING CO.

METAL CUTTING TOOLS

7775 CORTLAND AVENUE · DETROIT, MICHIGAN

Make it a Rule to Call Motor Tool

Replacement Parts Outlook

(*Continued from page* 77)

of axles, axle shafts, transmissions, transfer cases and gears, in certain types of trucks. Not only is the capacity for making such parts often assigned 100 per cent to war work but the alloy steel required for their manufacture is one of the critical materials in the war program. However, government officials have made assurances that military truck requirements may be held up temporarily to permit the producing of such parts if their lack is keeping essential civilian trucks idle, especially when such vehicles are playing a part in war production and transportation.

The gravest danger in the passenger car field may lie in the popular price class, where the volume demand for parts is greatest. Due to the steady demand for such fast moving parts, it usually has been customary for parts makers to maintain almost continuous production on these lines. Thus, distributors did not stock great amounts of such parts relative to the demand due to their immediate availability from the manufacturer. So if the facilities or materials for such parts are diverted to military needs, it is conceivable that a bad situation might develop. However, two factors may ameliorate this prospect. Under the Baruch Plan of car conservation, passenger vehicles will be used less intensively and there will be less demand for parts. Then also much is being done in the way of reconditioning of worn parts. Water pumps, fuel pumps and generators are rebuilt, spark plugs are reconditioned and valves are refaced. In the slower moving parts of models for which there is less demand, it has been possible to build up substantial stocks.

Much has been done in the truck field in the reconditioning and the reclaiming of parts, and this practice has been encouraged by the ODT. Drive shafts can be rebuilt, crankshafts and brake camshafts can be metal sprayed and other parts similarly conserved, thus minimizing the demand for new parts. The government may take some action to see that there is a fair distribution of this reconditioning equipment so that all sections can benefit by its use. With civilian truck output halted, aside from a recent order permitting the manufacture of 4000 heavy trucks, an effort has been made to use as many old trucks as possible and to keep them in service longer, whereas in peace-time it would be more economical to junk some of them. This likely will result in more breakdowns and a consequent demand for replacement parts. It is in the older lines of trucks and special types that parts shortages may develop, especially in forged parts.

Biggest threat to the continued manufacture of automotive replacement parts is the potential demands of the armed forces for spare parts for military vehicles, airplanes, tanks and combat vehicles. In the truck field, with the U. S. Army's fleet approaching a million vehicles, the military demands directly compete with civilian truck needs for replacement parts. This is particularly true now in the making of dual axles, transfer cases, transmissions and bearings, where production facilities in many plants are devoted 100 per cent to war orders. A similar condition exists in tank parts, where the same materials and productive facilities are drawn upon.

In the aircraft field, a combat airplane engine may require 15 to 25 times as many piston rings as an automobile engine, because replacement needs are estimated at 600 or 700 per cent of the original requirements. And each airplane piston takes approximately 10 times as many man-hours of manufacturing as an automobile piston. With the U. S. scheduled to build 60,000 airplanes in 1942, the tremendous demands upon the piston and piston ring productive capacity of the nation just for replacement purposes can be realized.

In the case of valves, not only are

(*Turn to page* 268, *please*)

Littell Pres-Vac Safety Feeder. Fig. 1 shown below, feeding flat pieces to punch press.

LITTELL *for* FASTER DEFENSE PRODUCTION

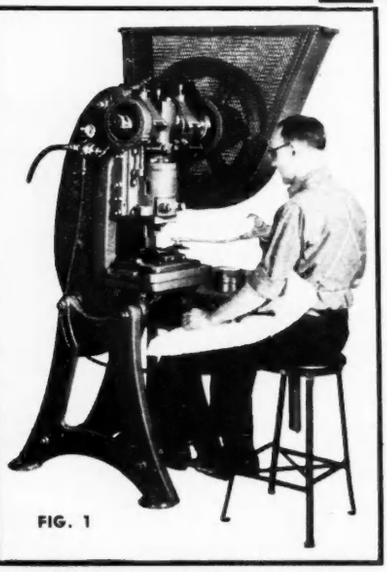


FIG. 1

Safety Feeders and Pickers

Don't take chances! Keep your workmen's hands out of danger zone. Feed flat pieces with Littell Pres-Vac Safety Feeder. Vacuum pickup. Trigger action. Protects hands. Speeds production. Mechanical Pickers also available. *Request Bulletin.*

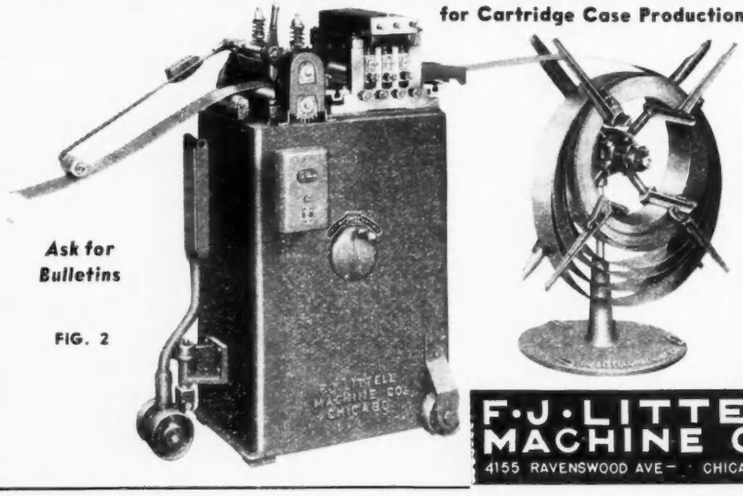


Littell Mechanical Picker. Can be fitted with various jaws to suit almost any type of work. Air operated.

FASTER Defense Production is assured with LITTELL Double Rack and Pinion Feeds, Automatic Centering Reels, Continuous Straightening Machines and Scrap Cutters, etc. LITTELL also makes other types of Defense Production equipment.
LITTELL Feeds are used for blanking and cupping small caliber cartridge cases—producing machine-gun cartridge cases—producing machine-gun cartridge clips—and for blanking and drawing ammunition boxes; also, for various other types of defense production work. Straighteners and Reels supply material to automatic punch presses. REQUEST DETAILS.

FIG. 2 (below). No. 308 LITTELL Continuous Straightening Machine. Supplies straightened material to automatic punch presses. Handles material up to 8" wide. Speed, 10 to 67 feet per min., using ¾ h.p. motor. Number and size of straightener rolls used depends on thickness of material. Littell Reel shown is 300-lb. capacity.

LITTELL—manufacturers of Dial Feeds for Cartridge Case Production.



Ask for Bulletins

FIG. 2

F·J·LITTELL MACHINE CO-
4155 RAVENSWOOD AVE— CHICAGO, ILL.

P. T. BOAT

With motors throttled to a mutter, the little boat slips cautiously toward the long shadow that looms against the stars.

Suddenly, aboard the warship, a siren screams, searchlights probe frantically over the waters . . . too late. The P. T. boat leaps in, launches its torpedo, and roars off at a tangent as a geyser of blinding flame towers upward into the night.

Powered and gunned by the automotive industry, handled by a tiny crew of daring men, these little P. T. boats pack a tremendous punch. They can deal a blow to destroy the biggest ship afloat.

Bethlehem is turning out steel for the P. T.'s marine engines, for their guns and shells, for the torpedoes they carry—as well as for the thousand and one other types of war production in which the changed-over automotive industry is hard at work.

Bethlehem structural steel has put a roof over a substantial part of the industry's war production; Bethlehem tool steel is busily engaged in cutting, boring and forging on assembly lines; Bethlehem plates, sheets, bars, and forgings are going into tanks, jeeps, peeps, trucks, guns and other war products now being made by the men who used to build automobiles.

Until the world struggle is won, we of Bethlehem will continue to supply the automotive war-production machine with the best steel and the most steel we can make. Our motto: "Nothing short of too much is enough."

BETHLEHEM STEEL



(*Continued from page* 264)

the demands for aircraft replacement valves extremely great but the military vehicle requirements also are at a very high level. When combat and cargo vehicles are being shipped to all parts of the world the spare parts problem is even more complicated because these parts must be on hand in every theater of war and allowance also must be made for loss of parts by enemy action while enroute. A comparison of automotive and aircraft valves finds 50 to 100 times as much labor expended on the airplane type as on motor vehicle valves. The aircraft replacement demand also is great due to the necessity for spare engines and spare sub-assemblies to keep combat planes in action. In fact, so heavy are the government needs upon the valve industry that the production of valves for civilian use has virtually ceased, at least temporarily, and automotive replacements will have to come from well stocked inventories.

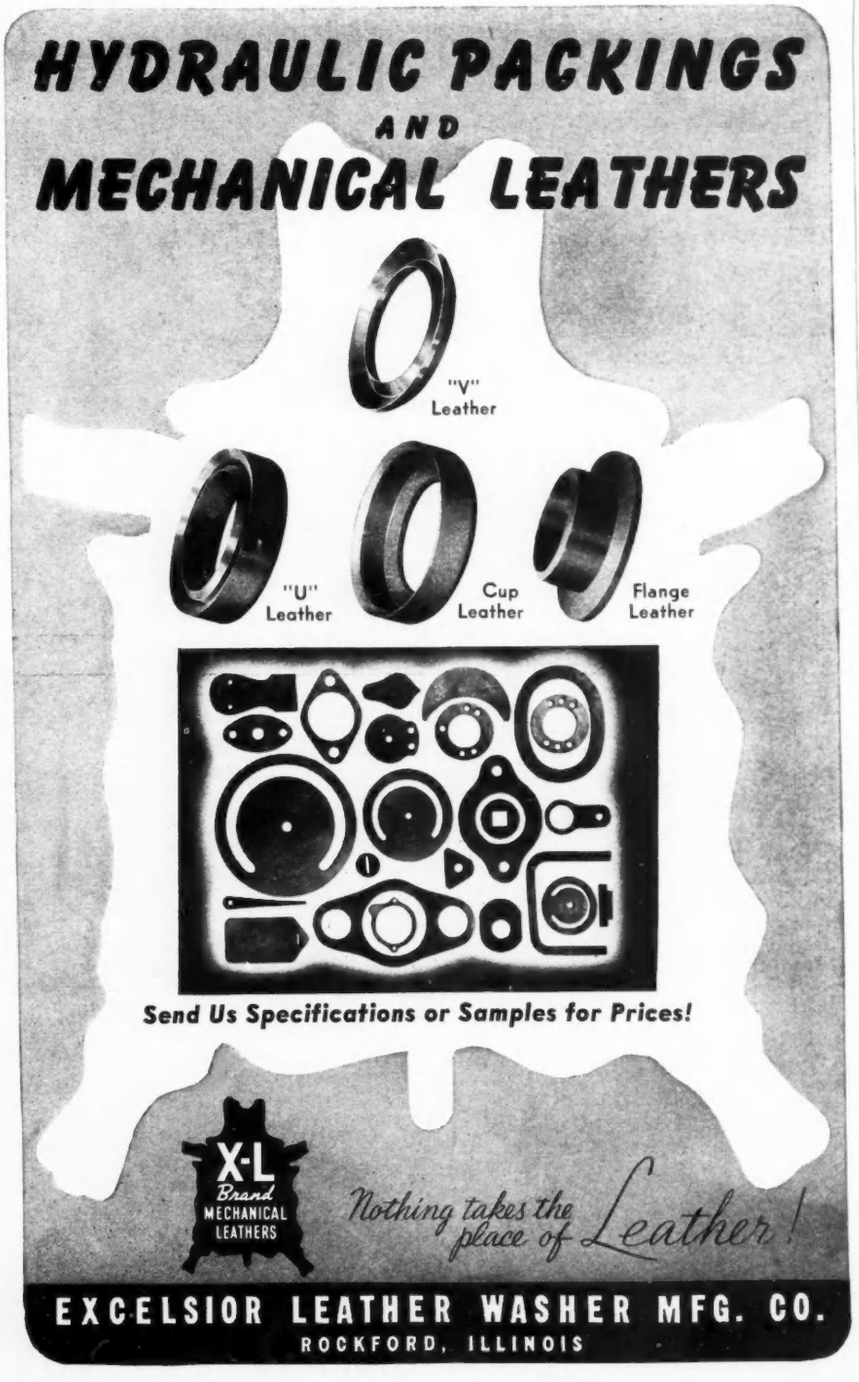
Aircraft spark plugs now being turned out by automotive suppliers cost six or seven times as much as automobile plugs due to the increased labor and the materials involved. A like situation prevails in the case of bearings, gears and other parts where there is a similarity between automotive and aircraft components so far as materials and manufacturing facilities are concerned. All this will have its effect upon automotive replacement parts. However, it is hoped that sufficient stocks of automotive parts can be banked up before the diversion to military spare parts becomes too pronounced.

Inventories have been a source of worry in framing the replacement parts orders. Under the amendments to L-4, which called for production at three times the abnormally high rate of 1941 output, it was intended to build up a two-year parts stock. But this was abandoned when it was found impractical and Order L-4-c included the limitation of producer inventories to four-month demands. L-158 retained this provision and also extended the inventory limitation to distributors, effective Aug. 15. Distributors in the Eastern and Central time zones are restricted to a 60-day stock measured in dollar cost value and distributors in the Mountain and Pacific time zones are limited to 90-day stocks.

L-158 found many jobbers, wholesalers and dealers with unbalanced parts inventories due to the general conditions prevailing last spring. Some were overstocked with certain items and lacked other parts. A provision of the order helps alleviate this condition, permitting a distributor to order a 30-day stock of any item where his inventory is abnormally low and below the 30-day figure, based on dollar volume of sales. This is permissible even when the additional orders bring the distributor's total inventory over the 60 or 90-day stock figure. Most jobbers carried at least a 120-day stock under normal business conditions. Now they have had to cut it one-third or one-half. These unbalanced inventories are being brought into line as distributors refrain from ordering many items and order others on a 30-day basis. They are "living off their fat," so to speak. But with the smaller inventories the distributors will be able to get a faster turnover and, theoretically at least, should be able to profit thereby.

The inventory limitations tend to discourage hoarding of critical parts and make for more even distribution of replacement parts between distributors, communities and states. This will make it easier for vehicles needing repair parts to obtain them some place in close proximity, without the necessity of canvassing the country-side for the particular part. Of course the inventory limitations do not prevent fleet owners or individuals from hoarding parts. Private owners are reported to have done this in respect to spark plugs, fan belts, radiator hose and even carburetors. But it has been discouraged and now the turn-in provision on worn parts will tend to minimize such practice.

There have been some complaints in certain sections over the sale by dealers, wholesalers and jobbers of replacement parts to Army camps and



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-STAMPINGS
-SUB-ASSEMBLIES

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Here is what we offer:

▶ 45 plants conveniently located from coast to coast.

▶ 7,738,500 square feet of floor space, part of which is available for additional war work.

▶ 16,000 workers (including machinists, engineers, draftsmen, tool and die makers) skilled in mass production of metal units.

▶ A competent sales staff operating out of 27 local sales offices which expedited the handling of an annual business in 1941 amounting to $136,652,016.

▶ A War Products Council organized to give you quick action . . . to help you or tell you promptly what you want to know about Continental's ability to handle any job. Write, wire or phone War Products Council, Continental Can Company, 100 East 42nd Street, New York City, or any sales office.

NOTE: *Continental is still turning out "packages to protect America" —cans to carry needed food to our armed forces, to our Allies and into American homes. We will continue to make these cans—as well as other containers for essential products as defined by WPB.*

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depots. Such purchases are authorized by the Army only on an emergency basis, except for vehicles bought prior to 1940. It is human nature for dealers and jobers to view this Army business as a lucrative market and a war-time substitute for decreased civilian trade. But on the other hand they are diverting replacement parts intended for civilian vehicles to military use and the manufacturers may not be able to make more of the same parts when civilian demand requires them. In the interest of their long-time civilian customers and of keeping essential civilian vehicles in operation, the dealers and jobbers would be more helpful to the war economy by concentrating on their regular market. Army camps and posts have been urged to buy from the manufacturers or regular wholesale channels except in the case of an emergency.

National Metal Congress

(*Continued from page* 167)

lower exhibit hall, and in the north exhibit hall and arcade of the Auditorium. In addition to the educational exhibits of more than 250 companies, many government agencies will be represented in conference displays.

The Exposition will be open daily from noon until 10:30 p.m. with the exception of Thursday when it will close at 6 p.m. Admission will be free to all members of technical societies and to those holding executive passes distributed by exhibiting firms. Members of any technical society can register upon presentation of their membership cards. Such registration provides admission to the Congress and Exposition for the entire week.

Some 100 papers will be presented at the regular sessions of the four co-operating societies—the American Society for Metals, the Wire Association, the American Welding Society and Iron and Steel and Metals Divisions of the American Institute of Mining & Metallurgical Engineers.

One of the features of the ASM Program will be a series of five daily lectures on tool steels by James P. Gill, chief metallurgist, Vanadium-Alloys Steel Co. All morning sessions of the ASM will be held at the Statler Hotel, headquarters during the week for this Society, while afternoon and evening sessions will be at Public Auditorium.

All morning sessions will be adjourned promptly at 11:30 to permit attendance at the meetings in the Statler Ballroom to be addressed by high government and War Production Board officials.

Other ASF events of outstanding importance will be the annual meeting and the Campbell Memorial Lecture on Wednesday morning, Oct. 14, and the annual ASM dinner Thursday evening, both to be held in the Statler Ballroom. John Chipman, Prof. of Metallurgy at Mass. Institute of Technology, will deliver this year's Campbell Memorial Lecture.

Several important awards will be made at the ASM dinner Thursday evening, with Benjamin F. Shepherd of Ingersoll-Rand Co., and past president of ASM, receiving the Albert Sauveur Achievement Award, and John C. Garand, inventor of the Garand Automatic Rifle, and member of the ASM. Springfield Chapter, receiving a special award. Dr. Oscar E. Harder will receive the President's Medal, and the Henry Marion Howe Medal will be awarded during the evening.

A symposium on rare metals will feature the A.I.M E.'s Metals division program, while production will be the theme of the Iron and Steel Division. Hotel headquarters will be at the Statler. The American Welding Society's headquarters will be at Hotel Cleveland, with the Wire Association at the Carter Hotel.



Plugging Along Together!

The services encountered in hotels of the Horse and Buggy Era were a far cry from services enjoyed in today's hotels . . . that's something to be thankful for in these critical times. Certain of these free and easy services adopted by progressive hotels, it seemed, were here to stay . . . we hoped they were here to stay, but now there's a war to be won . . . first things must come first. Haven't you noticed how most guests have patiently accepted necessary curtailment of services due to conservation of men and material needed to win the war? No one really puts up a howl . . . they know that such things also affect their business. They know that we are not lowering our American Way of Life (in hotels) . . . that soon will come the victory we all know must come and then . . . but don't put too low a price on victory . . . it's a 110% job for all . . . 100% for effort and 10% for War Bonds.

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HOTEL DESOTO ..... New Orleans
MISSISSIPPI
HOTEL LAMAR ..... Meridian
NEBRASKA
HOTEL PAXTON ..... Omaha

NEW MEXICO
HOTEL CLOVIS ..... Clovis
OKLAHOMA
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HOTEL ALDRIDGE ..... Wewoka
SOUTH CAROLINA
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TEXAS
HOTEL ALICE ..... Alice
HOTEL STEPHEN F. AUSTIN ..... Austin
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